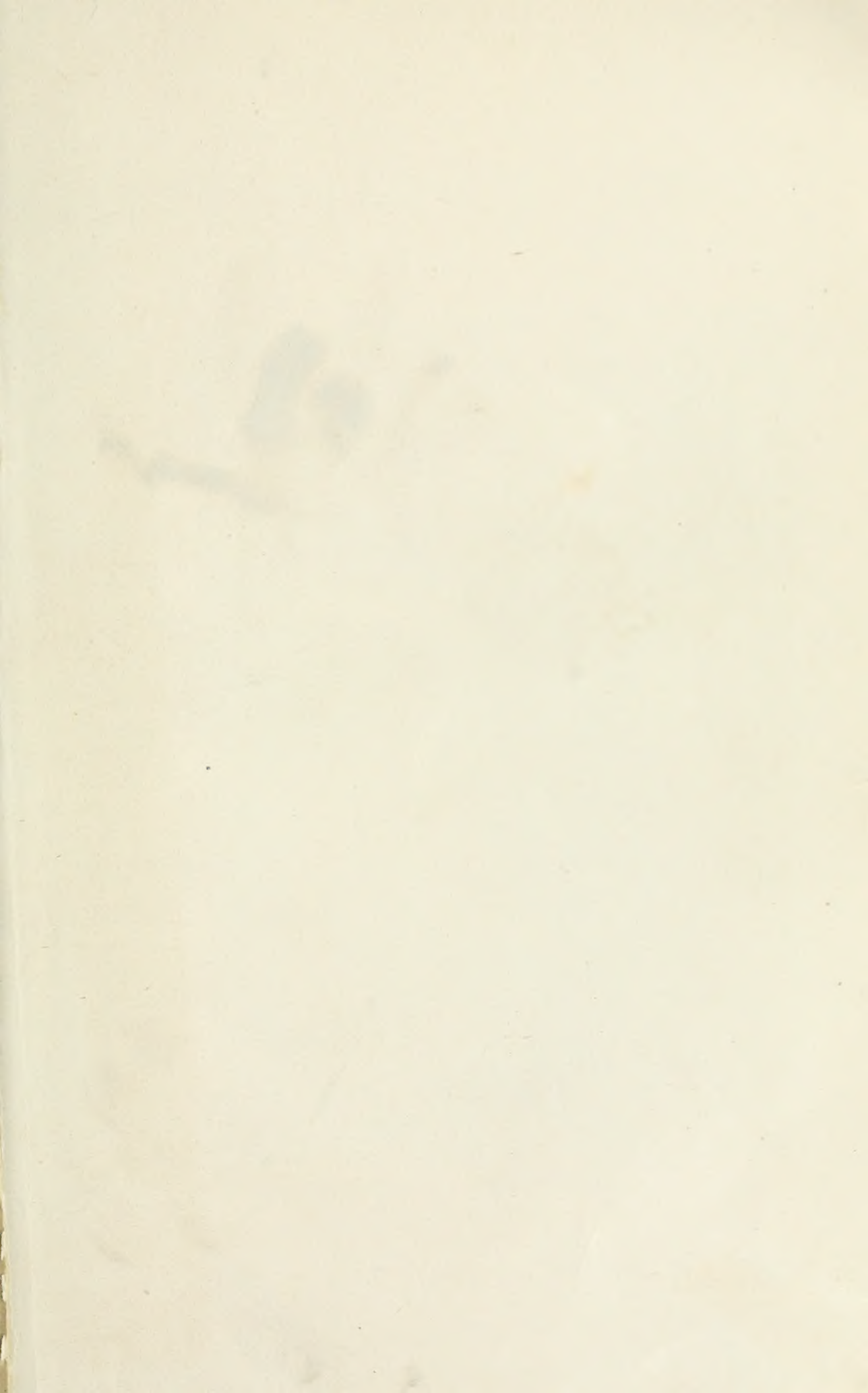




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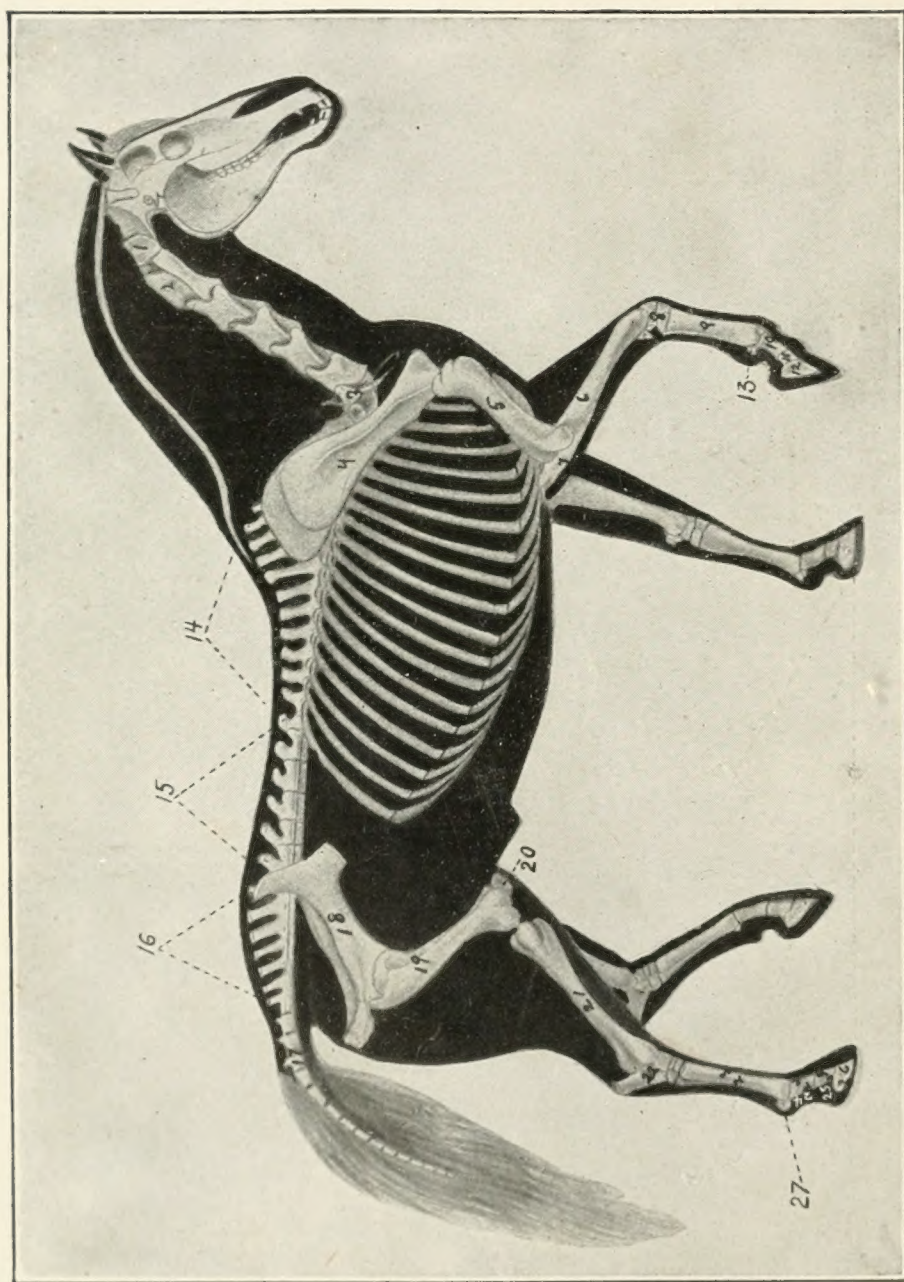


FIG. 1. SKELETON. (B. A. I.)

1, Atlas; 2, axis; 3, seventh cervical vertebra; 4, scapula; 5, humerus; 6, radius; 7, ulna; 8, carpals; 9, metacarpals; 10, first phalanx; 11, second phalanx; 12, third phalanx; 13, sesamoids; 14, dorsal vertebrae; 15, lumbar vertebrae; 16, sacral vertebrae; 17, coccygeal vertebrae; 18, pelvis; 19, femur; 20, patella; 21, tibia; 22, tarsals; 23, metatarsals; 24, first phalanx; 25, second phalanx; 26, third phalanx; 27, sesamoids.

VETERINARY STUDIES

FOR

AGRICULTURAL STUDENTS

BY

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ST. PAUL

PUBLISHED BY THE AUTHOR

ST. ANTHONY PARK, MINN.,

1903

97097-09
25/5-09

SF
745
R48

Copyright 1903
BY MYRON H. REYNOLDS.

First Edition off the press early in
November, 1903.

Second Edition printed early in
January, 1904.

Third Edition printed in
September, 1906.

Fourth Edition printed in
January, 1908.

Fifth Edition printed in
September, 1908.

PREFACE.

During ten years experience in teaching veterinary subjects to agricultural students, certain difficulties have been constantly encountered. Others doing this work have probably had similar experience. There has been the difficulty of imperfect training, or entire lack of training, in physiology and other subjects which medical men recognize as fundamental. There is always present the difficulty of presenting a technical subject in untechnical language; difficulty in securing satisfactory illustrations, and difficulty in giving the kind and character of veterinary work which is generally demanded and conceded as necessary, without giving our students a sort of training which will turn some of them into unqualified practitioners. There has been serious difficulty in covering, without a text book, a satisfactory amount of ground. Many students do not take notes well, and hence for several years I have been distributing mimeographed lecture notes to my classes.

During this time I have been more and more impressed with the belief that a text book, wisely illustrated and carefully edited for its legitimate use, would enable me to cover very much more ground within the available time.

The style of editing that has been adopted was selected with a view to presenting the subject matter to students in a conspicuous and easily grasped way. This must be our excuse and answer to criticism which the expert printer may legitimately make.

This work has been written more particularly as a text for veterinary classes in agricultural colleges, but it is hoped that it may prove helpful also to stockmen who are not able to attend our agricultural colleges, but who care to know more of the animal machines with which they are working. I take this occasion to deprecate the blind home-dosing of stock to which farmers and stockmen are very much inclined. The student should reali-

the impossibility of writing a prescription that will fit all cases of a certain disease, and if a good student he will hesitate to risk the use of medicines of which he knows very little in diseases of which he knows less.

Lecture notes which have been collected during a period of ten years have formed the basis for this work, and I am now unable, in many cases, to give credit to authorities that have been consulted, where credit is fairly due.

Illustrations have not been used in any case merely as pictures. Every one is intended to illustrate something and make that illustration as impressive as possible.

Suggestions to the teacher. It is not intended that this, as a text book, should entirely supplant the lecture work. On the contrary, nearly every lecture may be supplemented to advantage and so give opportunity for originality and the greatest effectiveness. It will be readily understood that certain subjects are of very great importance in some states, and unimportant in others. Each teacher should add what he thinks best for his grade of pupils and his local needs.

When time permits much time can be profitably spent on more extended anatomy work, especially for students who wish advanced live stock work. It can be readily illustrated and easily impressed; for instance, that smooth or rough hips depend upon a fraction of an inch, more or less, on the external angle of the ilium; and that high or low withers are merely slight variations in the length of the superior spinus processes of the dorsal vertebrae; and that conformation depends upon the bony skeleton and muscular developments.

Much time with considerable actual practice should be given to the study of unsoundness; to common forms of lameness, and the types of conformation which tend toward these unfortunate conditions. Common irregularities of the teeth are not discussed in these pages at all, and yet the general subject is an important and practical one, and one that is easily illustrated in class room. These are given merely as suggestions and to impress the fact that this text is not expected to cover the entire field of veterinary teaching for all agricultural colleges.

I respectfully suggest that teachers should insist upon careful study of illustrations. In my own class work I find the constant difficulty that students glance at the illustrations carelessly

and hurriedly, and thus fail to get the benefit which they might easily have from good illustrations. Students may be selected at random and asked to draw upon the board from memory, illustrations from the lesson for that day. After a few practice lessons of this kind students easily learn how to study text book illustrations.

M. H. REYNOLDS.

University of Minnesota, October, 1903.

PREFACE SECOND EDITION.

I wish to express my appreciation of the very kind reception which has been given to Veterinary Studies by my fellow teachers in agricultural colleges, by agricultural papers, and by stockmen.

There have been no material alterations in this edition, but I am planning to embody criticisms and suggestions in revising for the third edition.

M. H. REYNOLDS.

University of Minnesota, January, 1904.

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VETERINARY STUDIES.

LECTURE I.

ANATOMY.

Definition.—Science which treats of forms, structures and relations of body organs: These organs are divided for study into groups as follows: Bones, muscles, joints, nervous system, circulatory apparatus, respiratory apparatus, urinary apparatus and digestive apparatus.



FIG. 2. HORSE'S SKULL.

1, Premaxillary bone; 2, upper incisors; 3, upper canine teeth; 4, superior maxillary bone; 7, nasal bones; 8, lachrymal bone; 11, malar bone; 12, upper molar teeth; 13, frontal bone; 15, temporal bone; 16, parietal bone; 17, occipital; 20, styloid processes; 24, parietal crest; 25, inferior maxilla; 26, inferior molars; 28, inferior canine teeth; 29, inferior incisor teeth.

OSTEOLOGY, BONES.

Kinds.—Bones are classified as long, short, flat, and irregular.

Long bones, more or less elongated in form, medullary canal in shaft, found in limbs; example—humerus, femur, radius, and tibia.

The short bones are usually short in form, as the name implies. They have no medullary canal; example—carpals and tarsals.

Flat bones are those like the bones of the skull and the ribs, which consist of two plates of hard bony tissue connected by spongy bone.

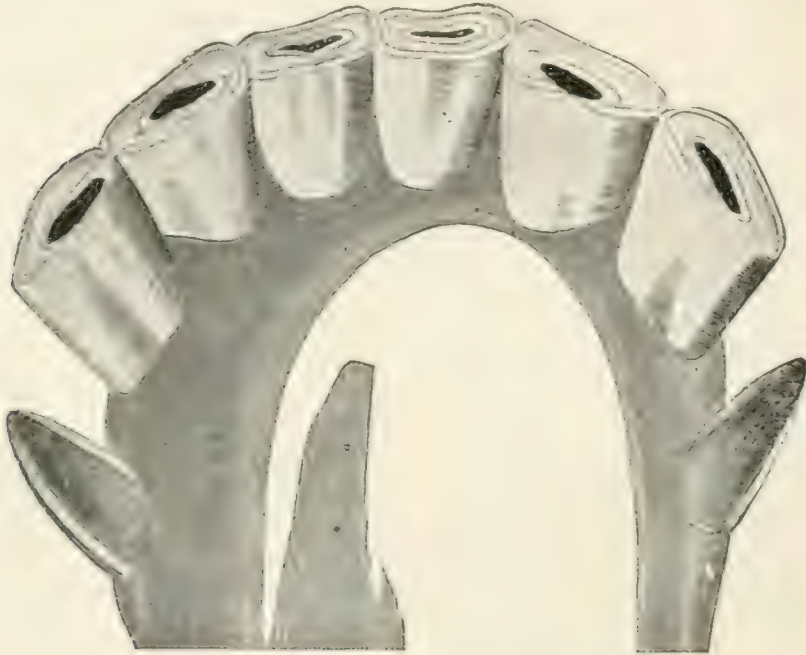


FIG. 3. SIX YEARS, LOWER JAW.

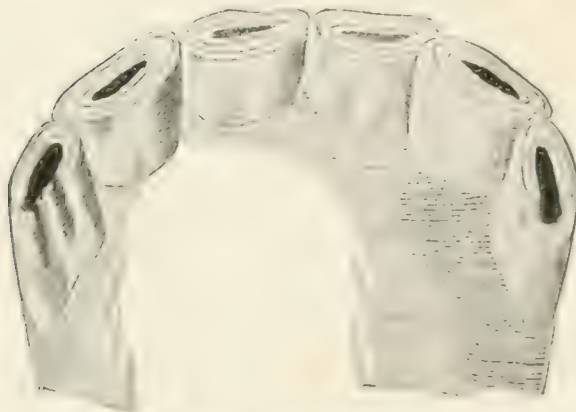


FIG. 4. EIGHT YEARS, UPPER JAW.

NOTE.—Figures 4 and 5 are drawn on different scales.

Irregular bones are usually found in the median line; example—vertebrae.

Peculiarities.—Used in describing and recognizing bones are: Elevations, depressions, borders, surfaces, angles, and extremities.

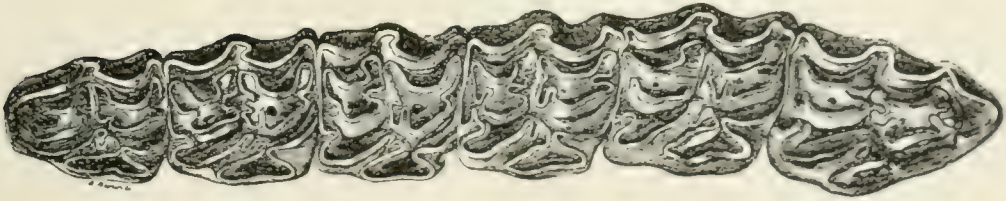
Development.—Bones develop either in cartilage or membrane. The long leg bones develop from cartilage; the flat skull bones develop from membrane.

Composition.—Normal bone of mature animals contains about one-third animal matter, and two-thirds mineral matter. Animal matter gives elasticity, the mineral matter gives firmness and strength.



FIG. 5. TWENTY YEARS, LOWER JAW.

A



B



FIG. 6. GRINDING SURFACES OF MOLARS.

Horse six to seven years old. A, right hand superior molars; B, left hand inferior molars.

Groups.—Bones are divided into the following groups for study: Head, spinal column, sternum, ribs, front limb, hind limb.

Head.—26 bones; cranium 9, hyoid 1, face 16.

Cranium 9; occipital 1, frontal 2, parietal 2, temporal 2, ethmoid 1, sphenoid 1.

Hyoid 1.

Face 16; superior maxillary 2, inferior maxillary 1, premaxillary, 2; palate, 2; malar, 2; lachrymal, 2; nasal, 2; vomer, 1; inferior turbinated, 2.

Teeth.—Mares have on each jaw: 6 incisors and 12 molars, or in all 18. Geldings and stallions have, in addition, 2 canines or tushes, making 20 teeth on each jaw. All the incisors and the first three molars are temporary and are replaced. The last three come in as permanent teeth, according to the following table.

Cattle have 8 incisors on the lower jaw and none on the upper. Their molars are like those of horses in number and the first three are also temporary.

DENTITION OF HORSES. (Chauveau.)

KIND	NUMBER	WHEN APPEAR	WHEN REPLACED
Incisors.....	Center	Birth	2½ years.
	Middle.....	4 to 6 weeks... ..	3½ years.
	Corner.....	6 to 9 months.....	4½ years.
Canines.....	4 to 5 years
Molars.....	1st.....	Birth.....	2½ years.
	2d.....	Birth.....	2½ years.
	3d.....	Birth.....	3½ years.
	4th.....	10 to 12 months..
	5th.....	2 years...
	6th.....	4 to 5 years.....

Age of horses by the teeth.—Tell by shedding and appearance of the teeth up to 4 years, according to table. Cups wear out of center pair of incisors of lower jaw at about 6 years; cups wear out of middle pair of incisors at about 7 years; and cups wear out of corner incisors at about 8; cups wear out of center incisors of upper jaw at 8, middle pair at 9, and corner incisors at about 10. Quality of the teeth, kind of food and the way the teeth fit together to be considered. They may wear very unevenly and be very deceptive. The upper incisors are much less reliable as to disappearance of cups than are the lower.

DENTITION OF CATTLE. (Chauveau.)

KIND	NAME OR NUMBER	WHEN APPEAR	WHEN REPLACED
Incisors.....	Center	Birth.....	1½ years.
	2d.	Birth.....	2½ years.
	3d	14 days.....	3½ years.
	Corner.....	14 to 21 days.....	4½ years.
Molars	1st.....	Birth.. ..	1½ years.
	2d.....	Birth.....	2½ years.
	3d.....	Birth.....	3½ years.
	4th.....	6 to 9 months....	Permanent.
	5th.....	2½ years.....	Permanent.
	6th.....	4 to 5 years.....	Permanent.

LECTURE II.

OSTEOLOGY.

Spinal column.—This consists of about 52 pieces, called vertebrae. There are 7 cervical, 18 dorsal, 6 lumbar, 5 sacral, 15 to 18 coccygeal.

There are certain general characteristics possessed by all vertebrae, regardless of location in the spinal column; for instance, each vertebra has a body, arch and spinal canal.

The *body* is convex in front and concave behind. The head of the body of each vertebra is rounded and fits perfectly into the cavity of the rear end of the preceding vertebra. Between each pair is considerable cartilage, which serves the purpose of an elastic pad.

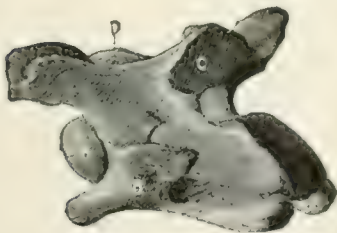


FIG. 7. TYPICAL CERVICAL VERTEBRA.

A, Head; B, transverse process; C, articular process; D, superior spinous process.

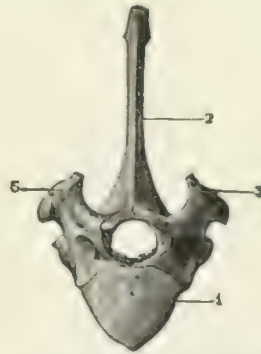


FIG. 8. TYPICAL DORSAL VERTEBRA, FRONT VIEW.

1, Head; 2, superior spinous process; 3, transverse process.

The *arch* is composed of the following parts: (1) The *pedicles* or stalks. These are the more or less narrowed portions of the arch which attach to the body on each side. (2) The *laminae* are the wider portions immediately above the pedicles on each side. (3) The *transverse processes* are the portions which project horizontally on each side from the arch. (4) The *superior spinous process* projects upward from the top of the arch. (5) The *articular processes* are four in number: two in front, and two behind. The former articulate with the posterior articular processes of the

preceding vertebra, and the latter with the anterior processes of the succeeding.

The body and arch develop from different centers of ossification.

Cervical vertebrae.—There are seven cervical vertebrae, all agreeing in certain general characters. The body is long, thick and has an inferior spine projecting downward from its under surface. The superior spinous processes are long from before to behind, and together form a long rough line.

The transverse processes are also long from before to behind. In these characteristics the cervical vertebrae differ radically from the others.

Special cervical vertebrae.—There are certain cervical vertebrae which have marked individual peculiarities. The Atlas, immediately supporting the head, has a small thin body with no head, but instead, two surfaces for articulating with the occipital bone.

The axis is long, and has, in place of the head, a peculiar projection known as “odontoid process.” This process is shaped somewhat like a tooth. Hence the name. The spinous process is long from front to rear.

The seventh cervical vertebra has a long spinous process, somewhat resembling those of dorsal vertebrae. It also presents a small articular surface for articulation with the head of the first rib.

Dorsal vertebrae.—Eighteen in number. These also have certain general characteristics. The body is short. There are four articular cavities, two in front and two behind for the heads of the ribs. Spinous processes are long and flat from side to side. Transverse processes short and small. None of the dorsal vertebrae differ very markedly from this general type.

Lumbar vertebrae.—In general the body is longer and wider than the dorsal. The spinous processes are also shorter. The transverse processes are also long, flat and thin.

Sacrum.—This consists of five pieces united in the adult. It articulates with the last lumbar vertebra in front, with the first coccygeal vertebra behind and with the pelvis on each side. This portion of the spinal column is triangular with the base forward.

Coccygeal vertebrae.—These are 15 to 18 in number. The spinal canal is developed in the first three or four. The first one is occasionally united to the sacrum.

The sternum.—This is located in the front and lower portion of the chest, and extends from before to behind. It consists of six or seven pieces of cartilaginous bone and has distinct prolongations of cartilage from both the front and rear ends. On each side are articular surfaces for the first eight ribs.

Ribs.—These usually number 18 pairs, and are described as the first, second, third, etc., beginning with the front pair. They all articulate above with the dorsal vertebrae, the lower ends of the first eight articulate with the sternum by means of cartilages. The remaining ten connect with the sternum by means of long cartilages, each of which rests against the preceding one. The ninth, or first asternal, rib is united rather closely to the eighth which articulates with the sternum.

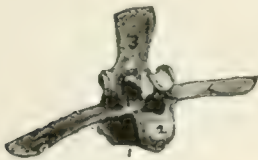


FIG. 9. TYPICAL LUMBAR VERTEBRA, FRONT VIEW.

1, Body; 2, head; 3, superior spinous process; 4, transverse process.

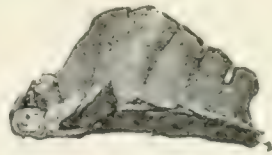


FIG. 10. LATERAL VIEW OF THE SACRUM.

1, Spinal canal, anterior portion; 3, superior spinous processes.

The *shaft* shows external convex, and internal concave surfaces and two borders: anterior or front, and posterior or rear. The *superior extremity* shows a head and a small projection, the tuberosity. These articulate with the dorsal vertebrae as already explained. The *inferior extremity* of each rib is somewhat concave for the cartilage which connects it with the sternum or other cartilages. The ribs increase in width up to the sixth, then decrease. Function of the ribs is to form a supporting and movable wall for the chest, protecting the soft organs and performing a very important function in respiration.

LECTURE III.

FRONT LIMB.

This limb is composed of 20 bones and includes the shoulder, arm, fore arm and foot.

The shoulder contains but one bone, the *scapula* or shoulder blade. It is triangular and situated at the front and lower portion of the chest wall. Its direction is downward and forward and it articulates below with the head of the humerus or arm bone. The inner surface is somewhat concave. The external surface is divided into two portions by a long ridge which extends lengthwise of the bone. The upper portion is flat and thin.

The arm contains a single bone, the humerus. The *humerus* is a long bone. Its upper end articulates with the scapula, and the lower end with the ulna and radius. It offers for description a shaft, and upper and lower extremities. A peculiar feature of the shaft is a sort of furrow, which twists around the bone and is known in anatomy as the furrow of torsion. The superior extremity shows a rounded head which is fitted for articulation with a corresponding cavity of the scapula.

The fore arm contains the *radius* and *ulna*, which in the horse and cow are firmly united. The radius belongs to the group classified as long bones and articulates with the humerus above and the carpal bones below. The anterior surface of this bone is convex and smooth; the posterior surface concave. The ulna is also a long bone, located just back of the radius. The shaft is triangular. The upper extremity shows a marked enlargement which is useful for attachment of muscles and gives leverage. It also contains a deep notch for articulation with the humerus. The inferior portion of this bone is slender and more or less pointed, containing at its extremity a small knob.

The foot includes seven carpals, three metacarpals, two sesamoids, three phalanges, and one navicular.

The *carpals* consist of seven small, short bones, and with the articulation of the carpals to the radius above, and the metacarpals below, make up what is commonly known as the knee joint.

The *metacarpals* are located in what is known as the region of the cannon. They are three in number: a large one in the middle, which is long and more or less cylindrical; and one rudimentary metacarpal on each side. These together articulate above

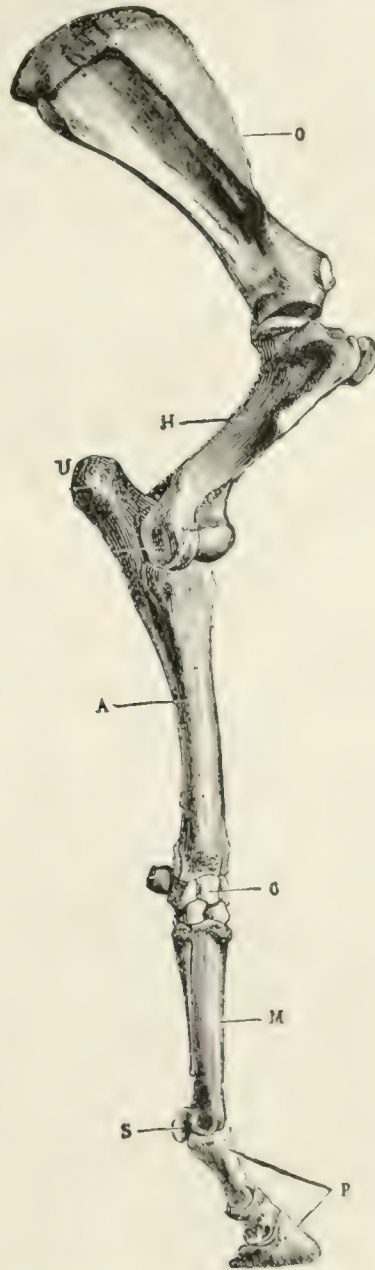


FIG. 11. ANTERIOR LIMB OF THE HORSE.

O, Scapula; H, humerus; A, radius; U, ulna; C, carpals; M, metacarpals; S, sesamoids; P, phalanges.

with the carpals, and the large one below with the first phalanx and the sesamoids. The small metacarpals are commonly known as splint bones.

The *first phalanx* is commonly known as the pastern. It is the shortest bone in the body that is classified as a long bone. The shaft shows an anterior, convex surface and a posterior surface which is flattened and rough. The upper extremity is marked by two shallow cavities, separated by a median groove and fitted for articulation with the two convex surfaces and the median ridge which mark the inferior extremity of the large metacarpal. The lower extremity has two articular surfaces separated by a median groove like that of the large metacarpal.

The *sesamoids* are two small, somewhat triangular, and irregular bones, placed side by side just back of the upper part of the pastern bone. These articulate with both the large metacarpal and first phalanx or pastern. They are side by side and together form a groove for the flexor tendons.

The *second phalanx*, or coronet bone, is short and somewhat square in form. It articulates with the first phalanx above, and the third phalanx and navicular below. The upper and lower extremities of this bone resemble the upper and lower extremities of the first phalanx.

The *third phalanx*, or pedal bone, is pyramidal in shape and irregular. Its superior face shows two shallow cavities separated by a median ridge fitted for articulation with the second phalanx. The anterior face is convex and quite rough. The inferior surface is the one on which the foot rests. It is called the sole. The superior border of the anterior face has quite a projection which is especially fitted for the insertion of a tendon. This is technically known as the pyramidal process. The lower portion of this bone is continued outward and backward on each side into what is known as the wing.

The *navicular bone* is located just back of the upper part of the third phalanx and is articulated to that bone. It is long and narrow, and placed transversely. Its anterior surface articulates with the third phalanx. Its posterior surface is covered with cartilage and forms a gliding surface for the tendon of the deep flexor muscle which passes over this bone to its attachment on the sole or inferior surface of the third phalanx.

LECTURE IV.

POSTERIOR LIMB.

This limb also contains 20 bones, and is divided for study into pelvis, thigh, leg, and foot.

The pelvis is divided into two halves, each half being composed of three bones closely united. These bones are distinct in early life, but become united as the animal grows older. The two halves of the pelvis bound the pelvic cavity which contains the rectum, bladder, and sexual organs. Each half of the pelvis articulates with the sacrum.

The thigh contains one bone, the *femur*, which articulates above with the pelvis and below with the larger of the two leg bones. The femur belongs to the group which we have classified as long bones and is the heaviest and strongest bone in the body. This bone offers for study a shaft, upper and lower extremities. The shaft shows three faces: external, internal, and anterior, which are smooth and convex, and a posterior face which is rough and irregular on the surface. There is a large projection on the upper portion of the posterior face called the internal trochanter. On the upper extremity we find a smooth rounded head which articulates with a deep cavity in the pelvic bone above. On the external surface and projecting above the head is the external or great trochanter. The inferior extremity is somewhat flat from side to side and shows two rounded surfaces which we will call condyles. These are separated by a deep groove known as the trochlea.

The leg contains three bones: tibia, fibula, and patella.

The *tibia* is a long bone with a somewhat triangular shaft, larger at the upper than at the lower end. It articulates above with the femur, patella and fibula, and below with the bones of the hock; i. e., the tarsal bones. This bone, like the femur, offers for study a distinct shaft, upper and lower extremities.

The *shaft* of the tibia presents three surfaces: the external,

internal, and posterior; and three borders—the anterior, external, and internal. The *superior extremity* shows in front a depression for one of the ligaments which attaches the patella to the tibia, a small articular surface for the fibula on the outer side; two oval depressions with a marked projection between them for articulating with the condyles of the femur. These are smooth and covered with articular cartilage. The *inferior extremity* pre-

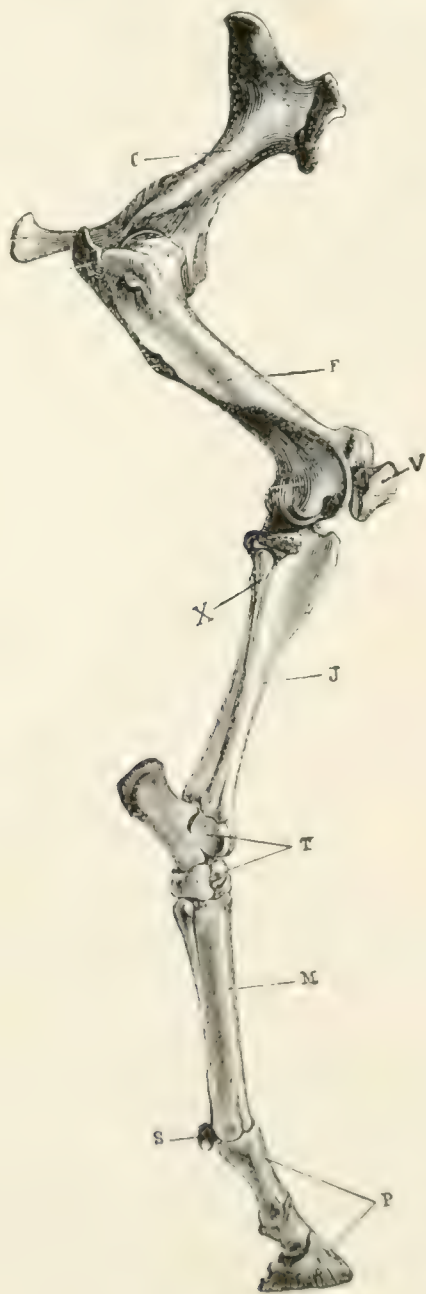


FIG. 12. POSTERIOR LIMB OF THE HORSE.

C, Pelvic bone; F, femur; V, patella; J, tibia; X, fibula; T, tarsals; M, metatarsals; S, sesamoids; P, phalanges.

sents an external and an internal tuberosity. Its articular surface consists of two shallow cavities and a median ridge, all three of which extend diagonally forward and backward.

This bone articulates with four others; viz., femur, patella, fibula, and one of the tarsal bones.

The *fibula* is a small rudimentary bone, which articulates with the external portion of the head of the tibia, and is situated on the external side of that bone.

The *patella* is small, short and located in front of the lower extremity of the femur, and attached to the tibia below by three strong ligaments. It is displaced outward when the limb is in the condition popularly known as "stifled." This bone offers for study three faces: superior, to which muscles are attached; the anterior, which is convex and somewhat irregular; and the posterior, which is so shaped as to fit nicely into the femoral groove already mentioned.

The foot bears a very close resemblance in its anatomy to the corresponding portion of the anterior limb, and is divided for study into the tarsus, metatarsus, and digit.

The *tarsus* is composed of six or seven small bones, arranged in two rows, the upper row containing the astragalus and os calcis. The lower row usually consists of four small bones. Two of these are especially interesting because they are the common seat of bone spavin.

The astragalus is interesting because it furnishes the articular surfaces for the lower end of the tibia.

The os calcis is somewhat elongated and lies behind the astragalus. It corresponds to the prominent portion of the human heel. The bones of this region correspond to the human tarsal bones making up the ankle.

The *metatarsus* consists of three bones, a large one in the center and one small rudimentary bone on each side; i. e., on the inside and outside of the middle bone. The large metacarpal furnishes the supporting axis for this region as in the anterior limb. The shaft is fairly smooth and has a small articular surface on each side for the rudimentary metatarsal. It is supposed that the small metacarpal and metatarsal bones are merely survivals in the process of evolution and that in the earlier history of the various animals from which the modern horse is descended

these bones were larger than they are now, having the same length and the same functional importance as the principal metacarpal and metatarsal bones. The original ancestor of the horse is supposed to have had five metacarpals and five metatarsals with corresponding digits or toes.

Each *digit* contains three bones known as the phalanges, the horse having three phalanges and the cow six. These are commonly known as the first, second and third phalanges, or *os suffraginis*, *os corona*, and *os pedis*. The anatomy of this region is discussed more fully in the special chapter on the foot.

The phalanges, sesamoids, and navicular bones are very similar to the corresponding bones of the front limb, already described.

LECTURE V.

ARTICULATIONS OR JOINTS.

Articulations are divided into several groups for the purpose of study. These groups are: immovable, slightly movable, and freely movable.

Examples: Immovable, between the skull bones; slightly movable, between vertebrae; freely movable, between scapula and humerus.

Freely movable.—The freely movable articulations are subdivided according to shapes of the articular surfaces and varieties of movement that can be produced. These subdivisions are: ball and socket, hinge, pivot, imperfect hinge, and gliding.

The *ball and socket* articulation, of which we find examples at the shoulder and hip, is made by a rounded head of one bone fitted into a rounded cavity of some other bone; for instance, at the shoulder we have a rounded head of the humerus fitted into a glenoid cavity of the scapula. At the hip a rounded head on the superior extremity of the femur fits perfectly into the cotyloid cavity of the pelvic bone. It will be readily seen that the ball and socket joint permits the greatest variety of movements.

The *hinge joint* is made by two articular surfaces of such shape and so fitted together that no lateral or rotary motion is possible. Only two movements are allowed at joints of this kind: flexion and extension. The articulation between the humerus above and the ulna and radius below offers a good example of this kind.

Pivot joint is one where portions of two bones are in contact in such a way as to permit of rotary motion; for example, between the Atlas and axis, the rotation being around the odontoid or tooth-like processes of the axis. Articulations of this kind permit of rotation only.

The *imperfect hinge joint* is one which permits of two principle motions—flexion and extension, and to a limited extent

some other motion, as for instance rotary or lateral movement. We may find a type of this articulation between the temporal and inferior maxillary bones, or between the femur and tibia. Articulations of this kind are formed by oval heads fitting in oval sockets.

Gliding joints permit only simple gliding movement between the articular surfaces. The articular surfaces in joints of this kind are more or less nearly flat.

Immovable.—At *immovable articulations* the bones are firmly united by cartilage and practically continuous with each other.

Slightly movable.—At *slightly movable articulations*, bones are united by a cartilage which is elastic enough to permit of slight movement, e. g., the common intervertebral articulations.

At *freely movable articulations* the articulating bony surfaces are each covered by a thin layer of smooth, glistening and elastic articular cartilage. This cartilage gives a smooth gliding surface. It also lessens jar by its elasticity and protects the bony surface beneath.

Structures at joints are bones, ligaments, tendons, muscles, synovial membrane, and synovial fluid.

Ligaments are either bands or sheets of white or yellow connective tissue. The white ligaments are very strong and inelastic. Their sole function is to hold bones together at articulations. The yellow ligaments are composed of yellow elastic connective tissue, and are especially useful as assistants to muscles, particularly in supporting parts of the body, like the head of the horse, which constantly tend to fall.

Synovial membranes are sometimes called capsules. These are serous membranes, quite thin, but composed of two layers, deep and superficial. This membrane affords at each joint a closed sack and is for the purpose of secreting synovia. Synovial membranes do not cover the surface of the articular cartilage as is frequently supposed, but usually enclose the articulations like sacks, being attached at one side near the edge of the articular surface of one bone, and at the other side near the articular edge of the other bone. The membranes are usually also attached to the inner surface of the capsular or other ligaments of the joint.

Synovia is a viscid fluid, slightly yellow or nearly colorless. It has an oily feeling, but is not an oil chemically. This fluid is quite rich in albumen which gives it the viscid property, and

adapts it so well for lubricating articular surfaces. Muscles and tendons are discussed in Lecture VI.

Kinds of motion are: *flexion* or bending, in which the two articulating bones are brought nearer each other; *extension*, the reverse of flexion, by which bones are straightened on each other; *adduction* bringing the lower extremity of the moving bone toward the median line; *abduction* in which the lower end of the moving bone is carried from the median line; *circumduction*, in which the articulation forms the apex of a cone circumscribed by the moving bone; *rotation* in which one bone rotates as a pivot on another.

Joints are named according to the bones involved. In the limbs the upper bone is named first. In the vertebrae, the anterior bone is named first.

DESCRIBING ARTICULATIONS.

Scapulo-humeral.—This is a ball and socket joint, the rounded head of the humerus fitting the glenoid cavity of the scapula.

Ligaments at this joint are: (a) Glenoid, a cartilaginous rim around the cavity which deepens the cavity; (b) capsular, a sort of capsule fitting around the joint like a bag; (c) two bundles of ligament fibers in front of the joint connecting the extremities of the scapula and humerus.

Movements.—All the motions, except true gliding, are possible at this articulation. The synovial membrane is quite loose and affords a lining for the capsular ligament.

First interphalangeal articulation.—This is an imperfect hinge joint. The articular surface of the inferior extremity of the first phalanx is characterized by two condyles and a median groove which fit with two shallow cavities and a median ridge on the superior extremity of the second phalanx.

Ligaments.—The articular extremities which make up this articulation are supported by the following ligaments and tendons: in front by the tendon of the anterior extensor muscle; on the sides by two lateral ligaments, one on each side; behind by the posterior ligament and the tendons of the shallow and deep flexor muscles which pass over the posterior of the joint. The posterior ligament is really a thick strong pad of fibro-cartilage.

Movements.—Flexion and extension, together with a limited lateral movement.

LECTURE VI.

MUSCULAR SYSTEM.

The peculiar property of muscle tissue is the power of self contraction and self movement. The muscles of the animal body are divided into voluntary and involuntary.

Voluntary muscles are under the control of the will through the cerebro-spinal system.

Involuntary muscles act independently of the will and are under the control of the sympathetic nervous system.

Voluntary muscles.—What is popularly termed “lean meat” is composed of voluntary muscles. These are classified into simple, digastric, biceps, triceps, penniform, bi-penniform.

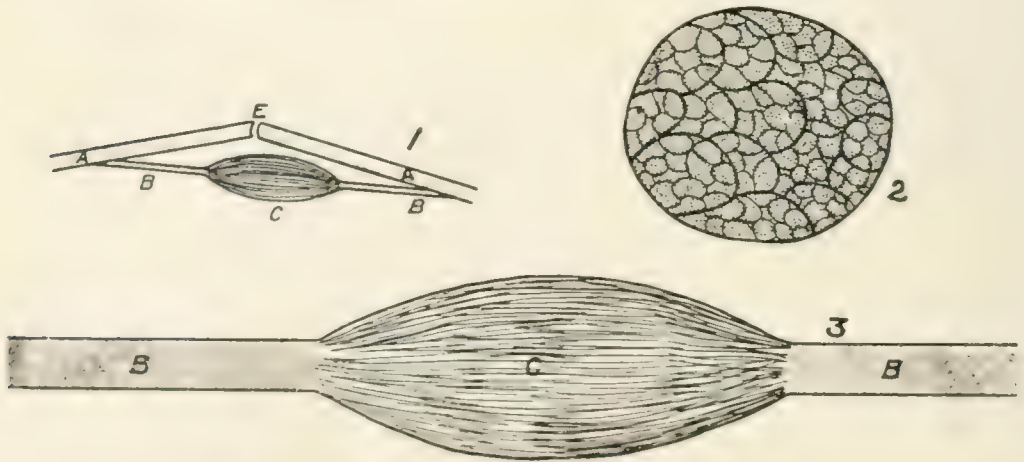


FIG. 13. VOLUNTARY MUSCLE. (M. H. R.)

1. Action of Muscle in Producing Motion. Muscle does its work by shortening its belly. A, A, Bones; B, B, tendons; C, belly of muscle; E, articulation (joint).

2. Muscle in Cross Section. Showing “bundle of bundles” arrangement of the fibers. Dots represent single fibers.

3. Diagram of Simple Muscle. B, B, Tendons; C, belly (lean meat).

A *simple* muscle is characterized by a single belly with not more than one tendon at either end: a *digastric* muscle has two bellies connected by a tendon: a *biceps* muscle has two tendons at one end; a *triceps* muscle has three tendons at one end; *penniform*, when the fibers attach to one side of a tendon; *bipenniform*,

or featherform, is characterized by fibers attaching to two sides of a continuous tendon.

They are also classified according to function into flexors, extensors, abductors, adductors, and rotators.

The *belly* is the active working part (lean meat). The *tendon* merely serves to give connection with a distant object, usually a bone. Tendons are strong but have no power of contraction. The strength of a muscle depends upon the thickness of the belly. The extent of its movement depends upon the length of the belly.

The two ends of a muscle are defined as origin and insertion. The *origin* is the less movable end; *insertion* the more movable end. It may happen at one time that one end is the insertion, at another time the origin.

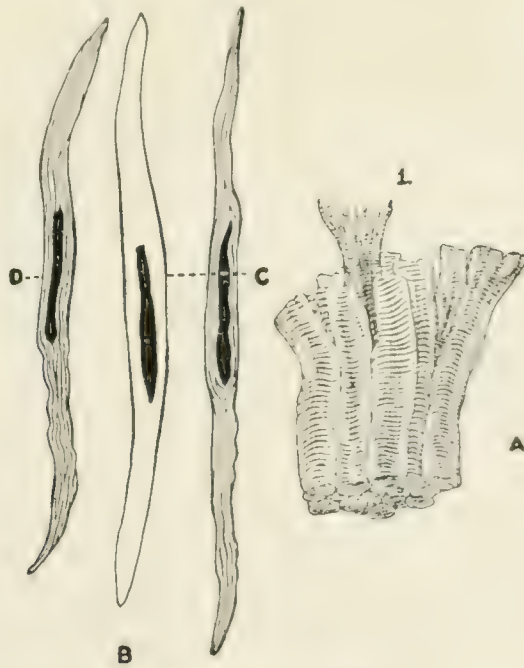


FIG. 14. MUSCLE FIBERS.

A, Bundle of voluntary fibers, side view. B, C, D, Three involuntary fibers, spindle-shaped cells with nuclei.

A muscle produces motion by pulling upon some bone which acts as a lever with the fulcrum at a joint.

The muscle fibers may attach directly to the bone, or indirectly through tendon fibers. The connection between the muscle fiber and the tendon fiber is by insertion of the conical point of the muscle fiber into a conical cavity at the end of the tendon fiber.

Structure.—The voluntary muscle consists of bundles of bundled fibers, each individual fiber has its own delicate sheath. A number of fibers are enclosed within a common connective tissue sheath and constitute a minute bundle. A number of these bundles are in turn wrapped within a connective tissue sheath, forming a larger bundle. These larger bundles may in turn be wrapped by means of another connective tissue sheath into a still larger bundle.

The voluntary muscle fiber is long, threadlike, marked by cross stripes which are very close together, and may end in tendon fiber. These muscle fibers are about 1-1500 of an inch wide, but may be very long.

Involuntary muscles.—Involuntary muscle fibers are merely long, spindle shaped cells, which do not end in tendon fibers. They may be arranged in the form of small bundles and are usually in the form of thin sheets. Involuntary muscle tissue is lighter in color than voluntary and usually encloses hollow organs forming one of the coats or layers. The middle coat of the stomach and intestines is composed of involuntary muscle fibers.

Function.—It is their function to carry on work which could not be entrusted to conscious control and with which the brain could not well be burdened.

Peristaltic action of the stomach and intestines is produced by the rhythmic action of these muscle fibers. The heart muscle fibers differ from both the typical voluntary and the typical involuntary fibers. They are striped but operate independently of the will.

Source of heat and power.—Muscular power comes from oxidation of food material in the various tissues of the body, particularly in the muscles and larger glands. During the process of oxidation, carbonic gas and other materials are developed. Power is increased by proper nourishment, and is decreased by lack of nourishment. Muscles lose in strength by over work because they are consumed more rapidly than rebuilt. Muscles are paired in a double sense. The rule is that for any given muscle there is a corresponding muscle on the other side of the body and also one or more opposing muscles on its own side.

The belly of a muscle has a rich blood supply; the tendon has very little.

Description of voluntary muscle.—The masseter muscle is located on the outer part of the cheek. *Form*, flat, broad, thick, four sided. *Origin*, on the temporal and superior maxillary bones. *Insertion*, on the outer surface of the inferior maxillary. *Action*, elevates the lower jaw. *Nerve supply*, from a branch of the fifth cranial nerve (trifacial).

LECTURE VII.

NERVOUS SYSTEM.

Function.—The peculiar function of the nervous system is to control the various organs and systems of the body, and compel them to work in harmony. The peculiar property of nerve tissue is irritability. The nervous system is composed of nerve centers, nerve trunks, nerve fibers, and nerve cells.

A *nerve center* is composed of ganglion cells, nerve fibers, connective tissue, and blood vessels. The function of a nerve center is to receive and dispose of impressions which may be

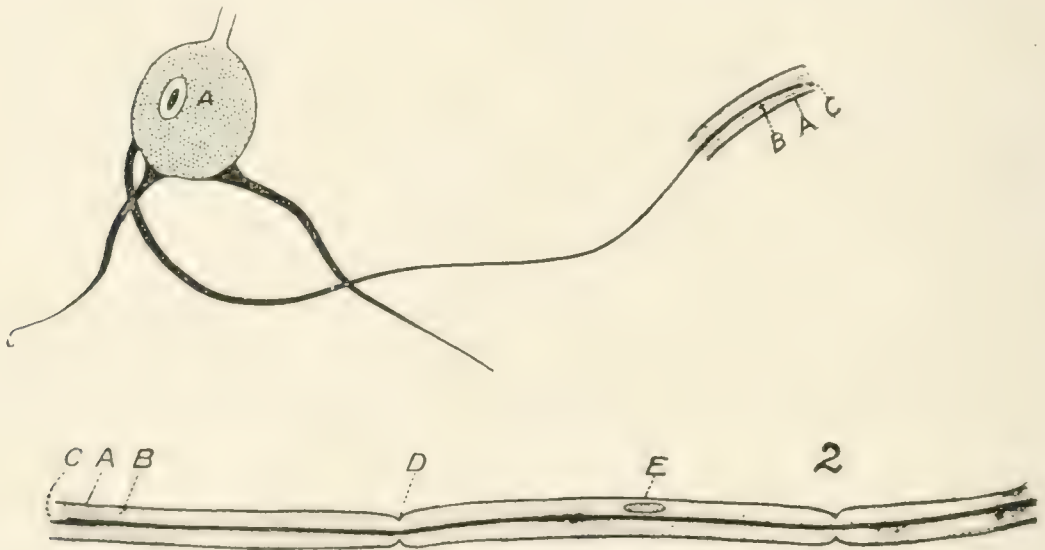


FIG. 15. NERVE CELL AND NERVE FIBER.

A. Nerve Cell with Several Poles. One pole continues as a medullated nerve fiber. A, Primitive sheath; B, medullary sheath; C, axis cylinder.

2. Medullated Nerve Fiber. A, Primitive sheath; B, medullary sheath; C, axis cylinder; D, node; E, nerve corpuscle.

brought to it, to connect nerve fibers, and in the case of the fore brain to originate conscious impulses.

A *nerve fiber* is composed in some cases of a central fiber surrounded by one or two protecting sheaths; in other cases, of the central fiber only. Nerve fibers conduct impulses between the various tissues and organs, and the nerve centers.

A *nerve trunk* is composed of an indefinite number of nerve fibers supported within a common sheath.

A *nerve cell* is an irregularly shaped microscopic cell, having a varying number of branches, one of which, in case of the motor cells, may continue to indefinite length as the axis cylinder or central fiber previously mentioned.

Nerve fibers are classified according to function into: motor, sensory, and special sense.

Motor fibers are those which convey impulses to the muscles and control muscular action.

Sensory fibers are those which convey impulses toward brain centers and supply only sensation to the structures to which they are distributed.

Fibers of *special sense*, as in olfactory, optic, and auditory nerves, transmit only sensations that pertain to the functions of the special senses, like hearing and sight.

Many of the cranial and facial nerves contain both motor and sensory fibers and are therefore mixed.

Nerve trunks are therefore classified as motor, sensory, mixed, and nerves of special sense, according to the kind or kinds of fibers composing them.

The nervous system is subdivided for study into the cerebro-spinal, and sympathetic nervous systems.

CEREBRO-SPINAL SYSTEM.

The cerebro-spinal nervous system consists of the brain and spinal cord together, with their nerves and ganglia. The brain and spinal cord should be considered as one complex organ located within a continuous canal; the brain to be considered as merely an enlargement at the anterior extremity. The cranial cavity should be considered as an enlargement at the anterior extremity of the spinal canal. The cranial bones may be considered as peculiarly developed vertebrae.

The **brain** is located in an ovoid cavity, the walls of which are formed by the cranial bones. It is covered by three membranes: (1) The *dura mater*, is tough, thick and strong, and exactly fitted to the inner surface of the cranial bones. (2) The *arachnoid* consists of two layers forming a closed sack, the outer layer fitted closely to the *dura mater*, and the inner layer fitted

closely to the pia mater. (3) The *pia mater* is thin, delicate, and fits closely to the brain substance—over the convolutions and into the depressions.

Gray matter, folded into convolutions covers the surface. The interior is composed of white matter.

Function.—The physiological function of the brain is to receive messages, consider information, and send out appropriate impulses or orders to the proper organs.

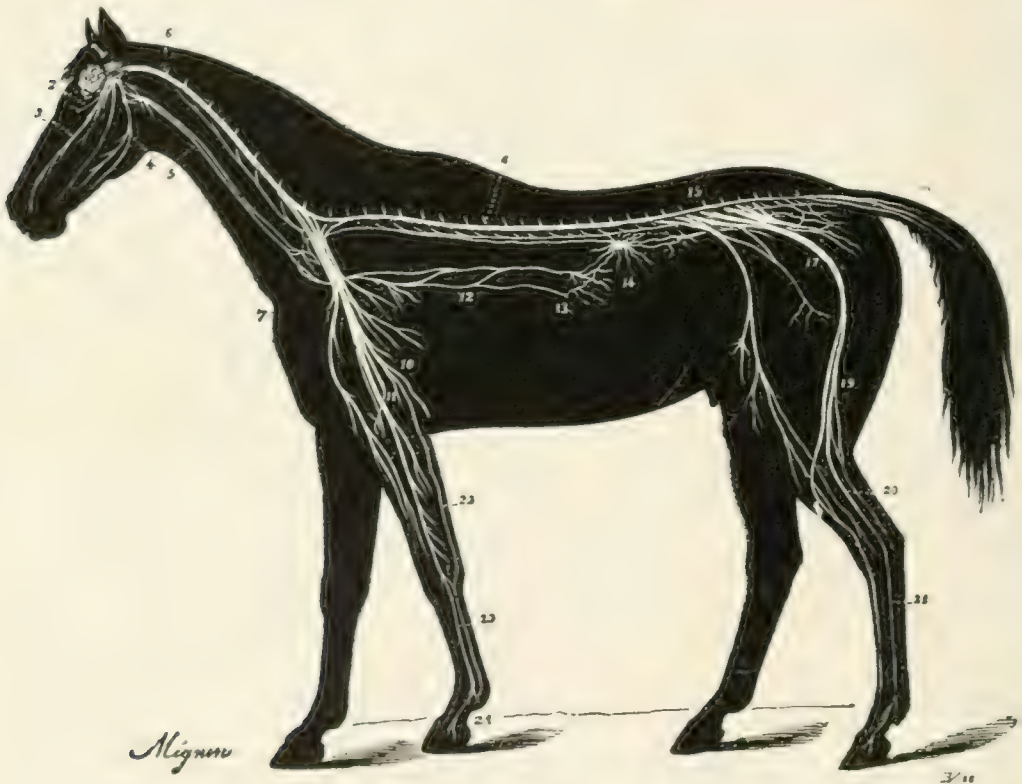


FIG. 16. CEREBRO-SPINAL NERVOUS SYSTEM.

1. Brain; 2, optic nerve; 3, superior maxillary nerve; 4, inferior maxillary nerve; 5, pneumogastric nerve; 6, spinal cord; 10, radial nerve; 11, median nerve; 12, pneumogastric nerve; 13, portion of solar plexus; 14, solar plexus; 17, sciatic trunk; 19, great sciatic nerve; 20, posterior tibial nerve; 21, posterior plantar nerve; 22, internal radial nerve; 23, anterior plantar nerve; 24, digital nerves.

Divisions.—The brain is divided for study into: (a) cerebrum; (b) cerebellum; (c) medulla; (d) isthmus.

The *cerebrum* is largest, and located in the anterior and superior part of the brain cavity, and is divided into two lobes or hemispheres by the median fissure.

The *cerebellum*, smaller than the cerebrum, is located in the posterior and inferior part of the brain cavity, and consists of three small lobes. Section shows the arbor-vitae (tree of life)

arrangement of nerve tissue. It is the function of the cerebellum to control the voluntary muscles that they may work in harmony.

The *medulla* is a continuation of the spinal cord and extends from the occipital opening in the brain cavity, to the pons or bridge and is located posterior and inferior to the cerebellum.

Within the medulla are located a number of important centers, among them, the ones controlling respiration; the caliber of blood vessels, distribution of the blood according to the needs of the body; the center controlling the processes of swallowing; the vomiting center; and the center controlling the secretion of saliva.

The *isthmus* is that part of the inferior portion of the brain which connects the pons with the cerebrum.

Cranial nerves.—There are twelve pairs, of which the first is *olfactory* (nerve of smell); 2nd, *optic* (sight); 3rd, *occulo motor*, to muscles of the eye ball; 5th, *trifacial*, to eye, skin of the face, teeth, etc.; 7th, *facial*, to muscles of face; 8th, *auditory*, to internal ear—hearing; 9th, *glosso-pharyngeal* to tongue and pharynx, sense of taste and general sensation; 10th, *pneumogastric*, sometimes called the wandering pair, distributed to heart, lungs, stomach, liver, intestines and other abdominal organs.

Spinal cord is that portion of the cerebro-spinal system which extends within the spinal canal from the occipital opening to the sacrum. It weighs about 10.5 oz. and consists of white matter on the outside and gray matter in the interior, and is covered by the same three membranes as the brain. The spinal cord is marked throughout its entire length by two fissures, one extending along the superior surface, and another along the inferior surface.

It is the function of the spinal cord to act as a means of communication between the brain and spinal nerves, and as a reflex nerve center.

Spinal nerves.—There are about 42 pairs. Each nerve has *origin* in two roots. One root (superior) comes from the upper portion of the cord and is composed of sensory fibers. The other root (inferior) comes from the lower portion of the cord and is composed of motor fibers. The nerve is therefore mixed.

These nerves *emerge* from the spinal canal in pairs, one on

each side and at each articulation of the vertebrae. They are *named* cervical, dorsal, etc., according to location in the spinal column.

The spinal nerves *supply*, by their superior branches, the skin and muscles of the neck and spinal column. By their inferior branches they supply the lower portion of the body and limbs and furnish other branches which in part make up the two great sympathetic nerve trunks.

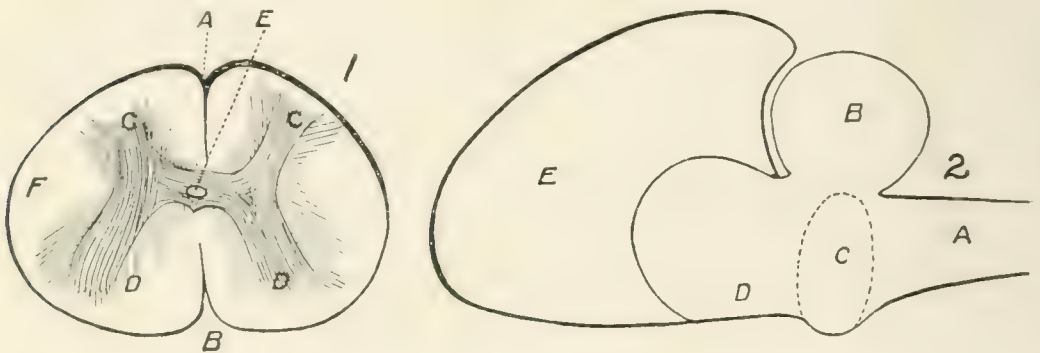


FIG. 17. SPINAL CORD AND BRAIN IN DIAGRAM. (M. H. R.)

1. Cross Section of the Spinal Cord. A, Superior median fissure; B, inferior median fissure; C, C, superior gray horns; D, D, inferior gray horns; E, central canal; F, white substance.

2. Vertical Mid-Section of Brain. A, Medulla; B, cerebellum; C, pons or bridge; D, isthmus; E, cerebrum.

THE SYMPATHETIC SYSTEM.

This consists of two cords, one on each side of the spinal column, and extending from the head to root of tail, together with all the nerves which branch from these two trunks. These cords are not smooth but have enlargements called ganglia at intervals along their course. Each cord resembles somewhat a small, rather flat and knotted rope.

Composition.—These two trunks are composed of nerves from the medulla and from the inferior branches of all the spinal nerves except the coccygeal. By this arrangement of composition and the frequent connections of sympathetic with cerebro-spinal nerves, there is constituted a very perfect union of these two systems into one great nervous machine.

Ganglia.—The knots along the two main trunks are ganglia of nerve cells and fibers. One of these, the solar plexus, is really composed of two large ganglia, united by a large cord and many

filaments. It supplies the stomach, intestines, liver, pancreas, spleen and kidneys. An injury to the solar plexus is always serious.

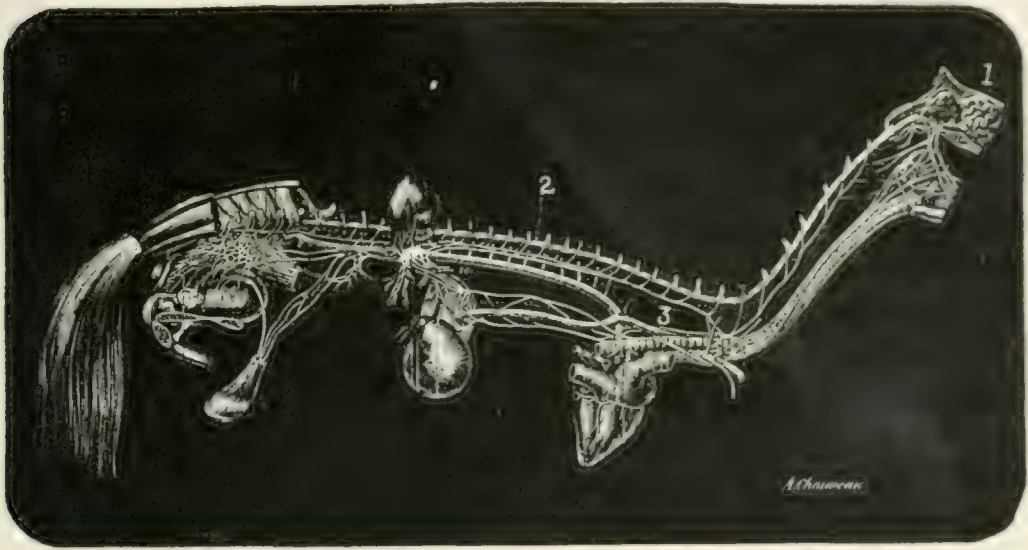


FIG. 18. RELATION OF THE SYMPATHETIC AND CEREBRO-SPINAL SYSTEMS. PARTLY DIAGRAMMATIC.
1, Brain; 2, spinal cord; 3, sympathetics.

Sympathetic nerves.—These control in part involuntary muscle fibers and through these the organs of circulation, respiration, and digestion, and in part the work of the various glands including the liver, spleen, pancreas, and kidneys. Sympathetic nerves are gray; cerebro-spinal nerves are white.

LECTURE VIII.

CIRCULATION.

Blood is a complex fluid consisting of serum, fibrin factors, and for present purposes two kinds of corpuscles,—the red and the white. Its temperature differs in the various domestic animals from 101 to 104 degrees F. The horse 100 to 101.5 degrees F. and the cow about one degree higher; sheep vary from 100 to 104 degrees. Its specific gravity is about 1050 and it constitutes about one-tenth the body weight.

Circulatory apparatus.—Heart, arteries, veins, capillaries, lymphatic vessels and lymph glands.

The *heart* is located within the pericardium, which supports the heart in place beneath the 3rd, 4th, and 5th dorsal vertebrae by attaching to the large blood vessels at its base; to the diaphragm behind, and to the sternum below. It measures about 10.5 inches in length by 7.5 wide at the base; cone shaped; and weighs 6.75 pounds. The heart contains four cavities, easily seen by cutting the heart open. Two located at the base are called auricles; and two at the apex, ventricles.

The auricles are much alike, as are also the ventricles, except that the left ventricle is larger and has a wall which is more than twice as thick as the right. The heart is covered by the pericardium and lined with the endocardium. Its muscle fibers are involuntary so far as control is concerned, but are striped.

Course of the blood.—Beginning with the blood entering the right auricle through the anterior and posterior vena cavae and coronary veins it then passes through the right auricle thence into the right ventricle, thence to the lungs through the pulmonary artery, back to the left auricle through four pulmonary veins, past the valves on the left side, to the left ventricle and is then sent by this ventricle through the systemic circuit. The systemic blood leaves the left ventricle through a large artery called the aorta.

The opening between the right auricle and the right ventricle is guarded by the right auriculo-ventricular valve; the opening between the right ventricle and the pulmonary artery is guarded by the right semilunar valve.

The opening between the left ventricle and the left auricle is guarded by the left auriculo-ventricular valve, and the opening to the aorta from the left ventricle is guarded by the left semilunar valve.

The *pulmonary circulation* is the flow of blood which occurs between the heart and lungs.

The *systemic circulation* is that which occurs between the heart and all the rest of the body, except the lungs.

Arteries, veins and capillaries.—Arteries have thicker and more elastic walls; remain open after death although empty; the stream flows in jets; the blood is lighter in color than that in the veins and flows from the heart. Arteries have no valves. In all these points the arteries differ from the veins. Both have three coats: outer, fibrous; middle, muscular; and inner, serous.

Capillaries are the small vessels and spaces which connect minute arteries with minute veins.

BLOOD SUPPLY OF THE BODY.

Arteries.—The aorta is the trunk artery which receives blood from the left ventricle for the systemic circuit. It is about two inches long and branches into two large trunks; viz., the anterior aorta and the posterior aorta. The anterior supplies the head, neck and front limbs; and the posterior supplies in a general way the rest of the body.

Anterior aorta is smaller and shorter (one inch long), course is upwards and forwards. It divides into the right and left axillary arteries. These lie near the trachea, one on each side, for a short distance and then bend around the anterior borders of the first ribs and terminate at the inner part of each shoulder in the humeral arteries, which are the continuing branches of the axillary. Each humeral furnishes blood for the corresponding front limb.

The *common carotid* arteries, right and left, supply various structures in the neck and head. These have their origin in a single vessel, the cephalic artery which branches from the right

axillary near the division of the anterior aorta into right and left axillary arteries.

A corpuscle, on its way from the heart to the brain would pass through the aorta, anterior aorta, right axillary, cephalic, and common carotid and then through a branch of the carotid to the brain.



FIG. 19. CIRCULATION. ARTERIES GRAY, VEINS WHITE.

1, Heart, right ventricle; 2, left ventricle; 3, left auricle; 4, pulmonary artery; 5, pulmonary veins; 6, anterior aorta; 7, carotid artery; 9, left axillary artery; 13, humeral artery; 14, radial artery; 15, metacarpal artery; 16, digital artery; 17, posterior aorta; 18, coeliac trunk; 19, mesenteric trunk; 20, renal (kidney) artery; 22, posterior vena cava (vein); 23, portal vein; 24, external iliac artery; 25, internal iliac artery; 27, femoral artery; 28, posterior tibial artery; 29, metatarsal artery; 30, venous supply to the foot; 33, jugular vein.

Posterior aorta curves upward and backward, through the diaphragm, then under the bodies of the dorsal and lumbar vertebrae to the lumbo-sacral articulation. This large artery supplies blood to the thoracic and abdominal organs, and then terminates in four branches named illiacs; two external and two internal.

The two external illiacs correspond somewhat to the two axillaries in front and the two femoral arteries to the two humeral, for it is the femoral arteries which continue the external illiacs and distribute blood to the posterior limbs and feet.

The two internal illiacs are smaller and distribute blood to the pelvic organs.

Veins.—These usually accompany arteries. One large vein commonly accompanies each large artery and two small veins accompany each of the smaller arteries; but this is not a fixed law.

The *anterior vena cava* corresponds to the anterior aorta and the *posterior vena cava* to the posterior aorta. Each returns the blood to the heart which its corresponding aorta has distributed.

All the veins except those of the bones, small veins in the feet and the veins of the brain and spinal cord, have valves.

Valves are most common and numerous in the veins of the extremities and in those veins which pass through and among voluntary muscles.

Pulmonary veins, four in number, have their origin within the lungs. They return blood from lungs to heart in the pulmonary circuit and carry pure blood.

The *anterior vena cava* has its origin between the two first ribs at the juncture of the two jugular and two axillary veins. Jugular vein corresponds to carotid artery, and axillary vein to axillary artery.

The *posterior vena cava* has its origin near the last lumbar vertebra by the union of the common illiac veins. It passes beneath and at one side of the bodies of the vertebrae, through liver and diaphragm to the right auricle of the heart.

LYMPHATIC SYSTEM.

Parts.—The *lymphatic system* consists of vessels and glands. The current in the vessels is like that in the veins in that it flows toward the heart and is very sluggish.

Lymphatic vessels.—These have thin transparent walls and are found in most of the body tissues. They have valves like the veins and carry lymph, or in the lacteals, chyle. The lacteals are lymphatic vessels which drain the digestive canal, chiefly the small intestines.

There are two main vessels: the thoracic and right lymphatic.

The *thoracic* is situated along the vertebral column within the abdomen and thorax, on the right side, near the heads of the ribs. Has its origin in one dilatation or receptacle and terminates in another before emptying into the anterior vena cava.

Its opening in the vein is protected by a valve in order that blood may not get into the duct. This duct drains all the body except the right side of the face, right side of head and neck, right shoulder and right front limb.

The *right lymphatic duct* is a very short vessel into which empty all the vessels which drain these latter regions.

Lymph glands.—The lymph glands serve in part to remove from the lymph disease germs and other harmful bodies. Their function is something like that of a filter.

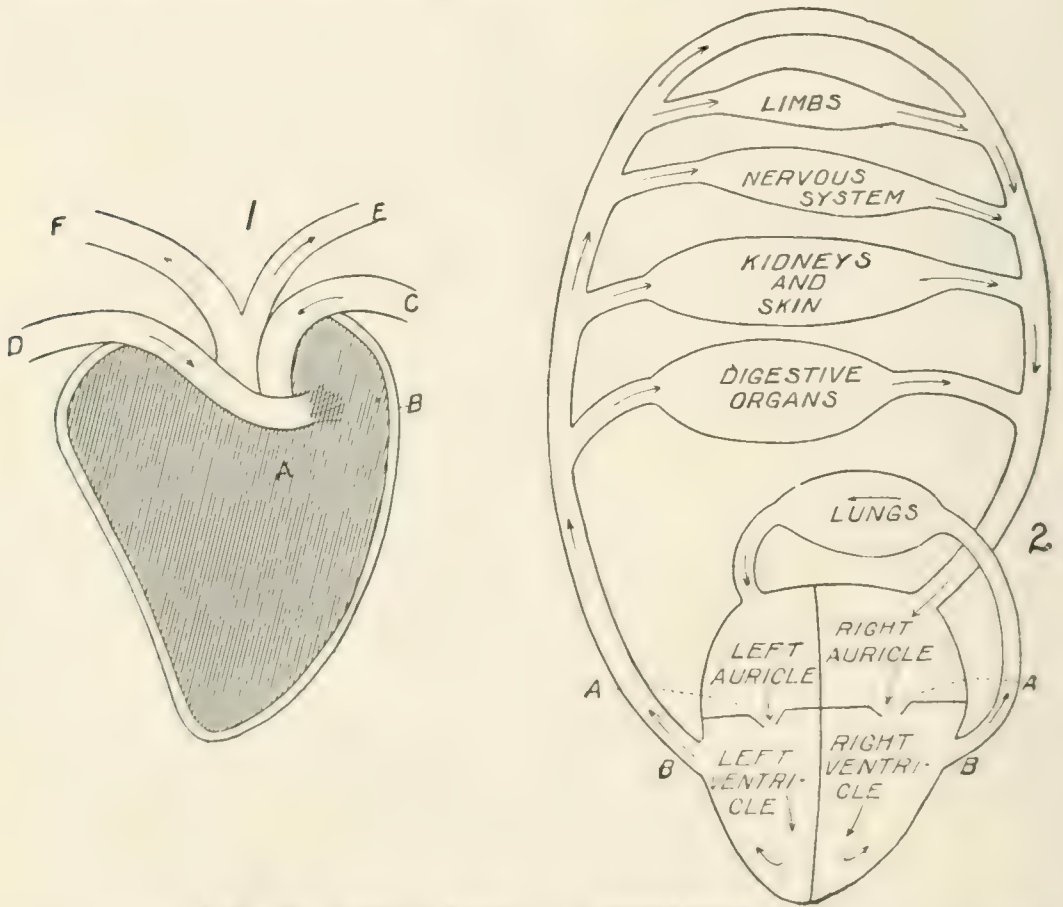


FIG. 20. CIRCULATION. DIAGRAMMATIC.

1. Heart and Blood Vessels. A, Heart; B, pericardium; C, anterior vena cava; D, posterior vena cava; E, anterior aorta; F, posterior aorta.

2. The Circulation in Diagram. A, A, Auricle-ventricle valves; B, B, semilunar valves.

Function.—The lymph fluid distributes nourishment by osmosis directly to the body tissues, and removes waste materials by the same process. The nutritious materials are as a rule taken into the lymph from the blood, and waste materials which the lymph receives from the tissues are poured into the blood through the thoracic duct and the right lymphatic duct.

LECTURE IX.

RESPIRATION.

Definition.—Respiration is the process by which the various tissues gain oxygen and give off impurities. Apparently, the plain simple purpose of respiration is two-fold: (1) to get oxygen into the blood and various body tissues, and (2) to get CO₂ and various other organic impurities out of the blood and body tissues. It is a common mistake to suppose that respiration is confined to the lungs. A very important portion of the true respiration occurs between the blood and individual tissue cells apart from the lungs.

Stages.—There are four stages in the complete act of respiration: (a) air comes into the lungs; (b) blood takes out part of the oxygen; (c) tissues take part of the oxygen away from the blood and give back to the blood carbon dioxide gas in exchange; and (d) the blood trades off its carbon dioxide to the air for oxygen.

Parts.—Respiratory system consists of nasal chambers, pharynx, larynx, trachea, bronchi, and lungs. These organs are all lined with mucous membrane. Function is to bring blood and air so near each other that the exchange may be rapid and the blood take away oxygen and leave waste matters.

Nostrils.—Two in number. These are openings at the front of the nasal cavities. The skin covering the nostrils is comparatively thin, quite sensitive and supported by cartilages. The mucous membrane lining the nasal chambers is divided for study into two portions, the upper in which are distributed the terminations of the olfactory nerves and the lower, the Schneiderian.

The inferior turbinated bones are located on the outer wall of each nasal cavity, two in number, scroll shaped.

Nasal cavities.—Two in number, one on each side of a median partition. This partition is composed of the vomer, a portion of the ethmoid, and the median cartilage. Each cavity con-

nects in front with the outside air through the nostril and behind with the pharynx through an opening which may be called the posterior nostril or technically, the posterior nares. Each chamber also connects laterally with the sinuses of the head (shown in class). The floor, roof and sides are formed by the various face bones together with portions of the frontal, ethmoid, and sphenoid, and the median cartilage already mentioned.

Pharynx.—This is a muscular sac situated beneath the cranium, and back of the soft palate which constitutes a partition between the pharynx and mouth cavities. This organ belongs to both the respiratory and digestive systems. Its walls are composed of two coats: the inner mucous and outer muscular. It connects by openings with the nasal chambers above, with the mouth in front, and with the oesophagus behind, with the lungs below, and on each side with the Eustachian tube to the middle ear.

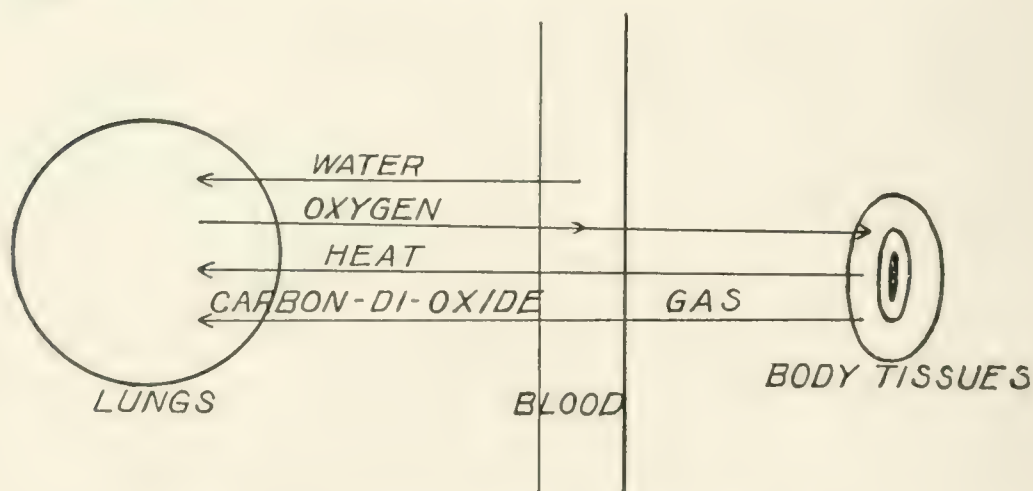


FIG. 21. RESPIRATION IN DIAGRAM. (M. H. R.)

Larynx.—A cartilaginous box located at the upper end of the trachea and composed of five pieces—one epiglottis, one thyroid, two arytenoids, one cricoid. Twelve muscles attach to these cartilages for the purpose of controlling them.

The *epiglottis* (a sort of lid) is a tongue-shaped piece of flexible cartilage which covers the entrance to the larynx. It is held down against the arytenoid cartilages when food is swallowed, but immediately afterward moves upward and thus opens the entrance to the larynx. It remains in this position during respiration.

The *thyroid* cartilage (shield like) is located at the upper and front portion of the larynx extending well around on the sides.

The *arytenoids* are two in number, one on each side. The two taken together are shaped somewhat like the front part of a pitcher, situated at the sides of the upper part of the larynx coming together at the median line. These cartilages give attachments to the vocal cords.

The *cricoid* is shaped like a ring with a process on the upper and front part, which causes this cartilage to resemble a seal ring. It is located at the lower portion of the larynx and connected with the trachea.

The *vocal cords* are a pair of narrow fibrous bands so situated as to include a narrow triangular space between them. They are attached in front to the thyroid and behind to the arytenoids.

Trachea, or wind pipe.—This is located beneath and in front of the esophagus. It is a long tube composed of about 50 cartilage rings beginning at the cricoid cartilage above and terminates at the bronchi below. It therefore connects the larynx and bronchi. It is lined by a mucous membrane which is covered by ciliated cells.

Bronchi.—Are two in number, are branches of the trachea and very similar to it in structure and function. One bronchus attaches to the root of each lung.

Lungs.—There are two, right and left. These are the essential organs of respiration, and located in thoracic cavity. Each lung is cone-shaped and enclosed in a separate pleural sack (explained), and the other layer of the pleura lines the interior of the thorax. In the lungs of a horse the lobes are not distinctly marked. Some authors make no definite divisions; others describe the right lung as having three lobes and the left, two. The lobes are then described as anterior, middle, and posterior, the left lung in the horse having no middle lobe.

In the cow's lungs the lobes are distinctly marked. The left lung has three distinct lobes. The right lung has four lobes by reason of the anterior lobe being divided into two parts: first and second.

The *root* is where bronchi and large vessels attach to each lung.

The *apex* is the point at the front part of the lung.

The *base* rests against the diaphragm.

The bronchi are subdivided until they are very small and are then called bronchioles. Each bronchiole terminates in a very small cavity made by a lot of air cells opening together. These cells have very thin walls and are separated by loose connective tissue, in which minute blood vessels are located. Blood is then separated from the air by only a very thin membrane.

LECTURE X.

DIGESTIVE APPARATUS.

Definition.—The digestive apparatus consists of various organs which carry on the processes of food reception, digestion and absorption. The digestive apparatus also expels various undigested and waste materials. The organs of digestion are the mouth, pharynx, oesophagus, stomach, and intestines, together with certain other organs; viz., the salivary glands at the mouth, and the liver and pancreas in the abdominal cavity.

Mouth.—At the mouth we find the lips, teeth, tongue, and palate.

The horse has a freely movable and sensitive upper lip, which is used in selecting food. The cow has hard cartilaginous lips and selects her food mainly by the tongue.

The tongue is used by the cow to select and gather her food, and by all animals to control the food while in the mouth and assist in swallowing. This organ is composed largely of muscular tissue with some connective tissue and is covered by the common mucous membrane. Its surface is studded with several kinds of papillae, similar to those on the human tongue. These aid in controlling the food while in the mouth and have to do with the sense of taste. They are especially prominent and strong on the cow's tongue.

The hard palate forms the roof of the mouth and consists of portions of the superior maxillary and palate bones covered by tough connective tissue, and overlaid with mucous membrane. This connective tissue and its covering of mucous membrane is thrown up into a series of transverse ridges, easily seen on the roof of a horse's mouth, sometimes called "bars."

The soft palate is a membranous structure containing some muscular tissue. Its function is to separate the posterior opening of the nose chamber and pharynx from the mouth.

The salivary glands on each side are: one parotid, one sub-

maxillary, one sub-lingual, and two molar. They secrete saliva which helps to change insoluble and useless starch into a soluble and useful sugar. It also assists in swallowing by so moistening the food that it passes easily along. This is especially important for animals like the horse, cow and sheep that live upon a dry and more or less bulky food. The horse needs on an average about 85 pounds and the cow 120 pounds every 24 hours.

The *parotid* is located behind the lower jaw and below the base of the ear. It is connected with the mouth by Steno's duct, through which its saliva flows to the mouth.

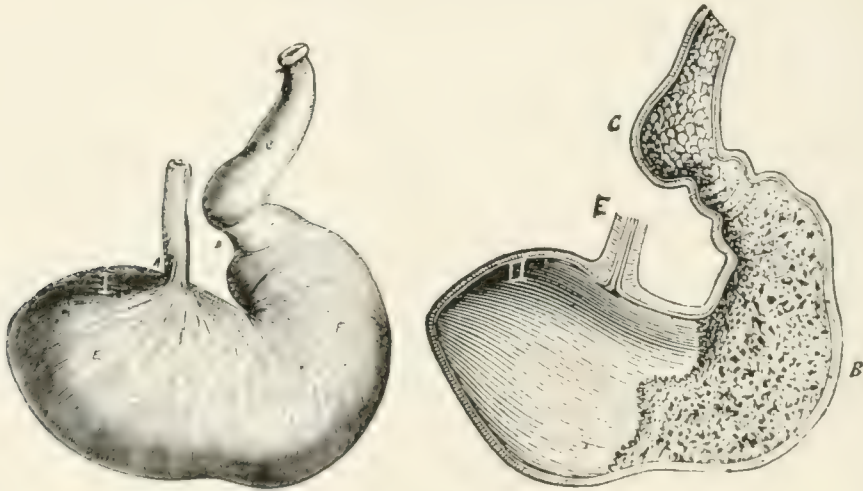


FIG. 22. STOMACH OF THE HORSE.

1. External View. A, Oesophagus; B, pyloric portion; C, duodenum; E, left sac; F, right sac.

II. Internal View. B, Right sac; C, duodenum; E, oesophagus.

The *sub-maxillary* lies in the space between the flat portions of the inferior maxilla, external to the larynx. Its saliva reaches the mouth through Wharton's duct, which opens at the side of that portion of the tongue where it attaches underneath.

The *sub-lingual* lies beneath the tongue and its saliva escapes into the mouth through 15 or 20 small ducts, the ducts of Rivini.

Molar glands are two in number on each side and are located near, and opposite to the molar teeth.

The *pharynx* belongs to both the digestive and respiratory systems and was described in the lecture on respiration.

The *oesophagus* is a slender tube 6 to 9 feet long, 1 inch in diameter, connects pharynx and stomach, quite elastic. It is

composed of two coats. The inner is mucous membrane; the outer is muscular and composed of two sets of fibers. One set encircling the oesophagus and the other placed lengthwise.

The stomach is located in the anterior portion of the abdominal cavity. The horse's stomach, when cut open, shows two distinct portions. The mucous membrane which lines the interior on the left side is light colored, firm and tough, like the mucous membrane of the oesophagus of which it is a continuation. On the right side of the stomach the mucous membrane is soft and red. The horse's stomach holds about $3\frac{1}{2}$ gallons, and the cow's stomach about 45 gallons. The function of the stomach is to receive food and furnish gastric juice. Stomach of the cow is compound, with **four** cavities. The first cavity, the paunch, is much the largest and acts as a sort of storage vat. Gastric juice is furnished by glands in right side of horse's stomach, and by cow's fourth stomach. Effect of gastric juice is to make proteid matters soluble, which it does by the action of its pepsin ferment which is very active. The quantity of gastric juice used by horse and cow varies from 100 lbs. to 170 lbs. in 24 hours.

The small intestine.—This begins at the stomach, the common opening being guarded by the pylorus, a strong sphincter muscle like a purse string. The small intestine is divided into three parts duodenum, jejunum, and ileum. The small intestine is about 72 feet long in the horse and 140 feet in the cow, and extends from the stomach to the caecum at which point the large intestine begins.

The stomach, small and large intestine have the same three coats: inner mucous, middle muscular, and outer serous.

The *mucous coat* in the small intestines is thickly studded with villi. Various intestinal glands furnish fluids which assist in digestion.

The *muscular coat* is composed of two sets of fibers, those of one set encircling the bowel, and those of the other set are lengthwise for the purpose of producing peristaltic action of the intestines.

The *outer coat* is the peritoneum, a serous membrane which

lines the abdominal cavity and also covers the various abdominal organs.

The liver is the largest gland in the body, weighing about 11 lbs. and is situated in the abdominal cavity on the right side and well forward against the diaphragm. It manufactures about 12 lbs. of bile in 24 hours. The liver shows four fairly distinct lobes, named—the left, right, middle, and Spigelian. The liver is enclosed in a strong capsule called Glisson's capsule. The cow has a gall-bladder, but the horse has none and the bile flows more or less constantly into the intestine. The *bile* aids somewhat in digestion of fats. It has also a slight cathartic effect: it aids absorption and tends to prevent putrefaction. The liver cells convert sugar from the blood into animal starch (glycogen), and store it up as such and finally they reconvert this glycogen into soluble sugar and give it out to the blood in proportion as the blood loses its sugar.

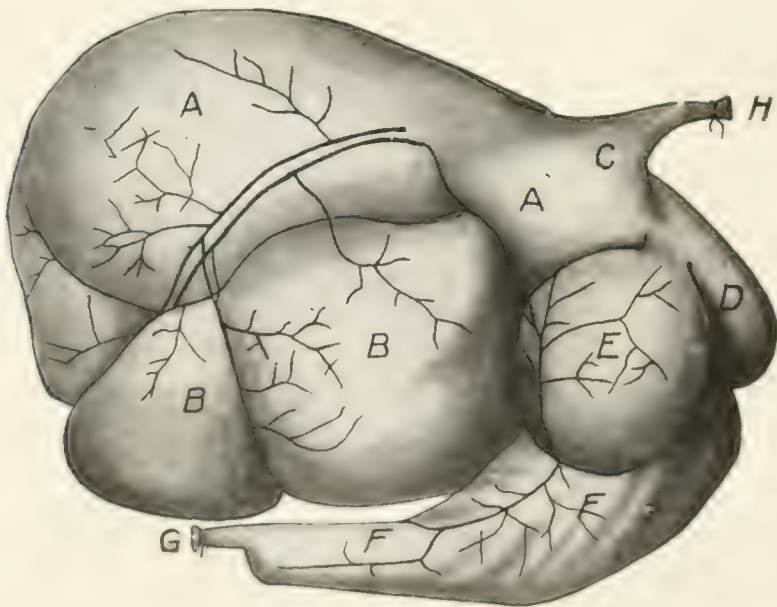


FIG. 23. STOMACH OF THE COW.

A, A and B, B, Different portions of the paunch or rumen; C, termination of the oesophagus; D, second stomach (reticulum); E, third stomach (omasum); F, F, fourth stomach (abomasum); G, small intestine, just beyond the pylorus; H, oesophagus.

The pancreas, smaller than liver, weighing only 17 oz., but it furnishes about 11 lbs. pancreatic fluid daily. Located in abdominal cavity below aorta and behind stomach and liver. Ends

are called head and tail. Shape is long triangular. Much like a big salivary gland. Pancreatic fluid empties into intestine at or near the bile duct. This fluid contains four different ferments: one acts on starch, one on protein, one on fats, and one curdles milk. This is probably the most important of the digestive fluids.

The large intestine is about 25 feet long in horse, capacity 33 gallons. In cow 42 feet long, capacity 18 gallons. Parts: Caecum, large colon, small colon.

Caecum (blind pouch) in horse $3\frac{1}{2}$ feet long, capacity $7\frac{1}{2}$ gallons. Important in digestion of cellulose.

Large colon in horse 12 feet long, capacity 20 gallons.

Small colon in horse 10 feet long, capacity 6 gallons. In cow large and small colon are studied together, and are 35 feet long, with a capacity of 14 gallons.

Large intestine of both animals is long, large and sacculated to hold contents a long time and offer a large amount of absorbing surface. It takes contents about five days to pass through the alimentary tract of cow, and about three days to pass through that of horse.

LECTURE XI.

PHYSIOLOGY OF DIGESTION.

Definition.—Digestion is a chemical process by which food matters are made soluble and capable of absorption.

The digestive fluids are saliva, gastric juice, pancreatic juice, bile, and intestinal juice. These are the active agents which bring about the chemical changes necessary to make food matters soluble.

Food groups are of two general classes: organic, and inorganic.

The organic group is divided into three sub-groups: *carbohydrates* (sugars and starches); *proteids* (egg albumen, casein, gluten, etc.); and *hydrocarbons* (fats and oils).

The inorganic group includes water, lime, sulphur, phosphorus, etc.

COURSE AND HISTORY OF FOOD GROUPS.

Carbohydrates.—Starch cells are broken up by the teeth and the starch is changed by the saliva, and pancreatic juice, into soluble sugars. Physiologists differ somewhat as to details, but during the process of digestion at least two sugars—dextrose (grape sugar), maltose, and dextrine, an intermediate body between sugar and starch, are formed. After these chemical changes comes absorption, then distribution. A large part of the starch products are taken into the portal circulation and carried to the liver. The remainder enters the general circulation. The portion carried to the liver is there changed back to a form of starch, called glycogen. As the blood loses its sugar, it is resupplied from the liver. Thus the liver becomes a store house for surplus sugar and at the same time acts as a balance wheel, in maintaining a uniform percentage of this material in the blood. The sugar is ultimately oxidized, liberating heat, CO₂, and water. These are excreted by the skin, lungs and kidneys.

Proteids.—These are not affected by the saliva, but are changed to soluble peptone by the gastric and pancreatic juices, then absorbed into the blood current and ultimately distributed to tissue cells of the body to replace worn out parts or to build up new parts in growing animals.

It has been held that proteid matters were especially necessary to repair tissue worn out by mechanical work; but there is good reason to think that this has been overestimated in the past, and that the carbohydrates have much to do with the ultimate source of physical power.

It is probable that surplus proteids are extensively converted into fat, and stored as such in the tissues of the fattening animal, or excreted as butter fat by the milch cow or nursing mare. The remaining proteids are finally oxidized, and excreted from the body as urea and water. The urea is mainly excreted by the kidneys and the water by all the excretory organs.

Fats, or hydrocarbons.—These are digested mainly by the pancreatic fluid. They are not acted on by either saliva or gastric juice and but slightly by the bile. The pancreatic fluid emulsifies a portion which reaches the lacteals in this condition. The remainder is digested by separating the glycerine from the fatty acid (fat consists of a fatty acid plus glycerine). Glycerine is readily soluble and easily absorbed. The fatty acid unites with alkaline material from the bile and pancreas to form soluble soap and thus the remainder of the fat is absorbed. Then comes absorption of this emulsified and digested fat, distribution in the blood current, and finally assimilation, i. e., building into cell tissues or oxidation. It may be deposited either into and become a part of the cell bodies or it may be deposited between the cells and thus become a stored reserve. Under some conditions this storing up of fatty matter may constitute a diseased condition, as when the heart muscle undergoes fatty infiltration or degeneration. The final changes which fats undergo are oxidation and then excretion as CO_2 and water.

Suggestions.—Mature animals need a constant supply of food to supply heat, and energy for physical work and in the case of fattening animals for conversion into storage fat. Young and growing animals must have food to supply heat and energy for physical work, and in addition food from which new cells may be built.

The more thorough the digestion and absorption, the better will be the returns for food consumed.

Thorough digestion with imperfect absorption means wasted feed, and useless work for the digestive organs.

Generous feeding therefore is not enough. It must be done intelligently.

Best results are secured when the bowels are in a medium condition between diarrhoea and constipation.

Both digestion and absorption and through them good or bad results in feeding depend to a considerable extent upon the condition of the mucous membrane lining the digestive tube and through which absorption must take place.

Water horses before feeding and do not give more than one-half pail within an hour after feeding, if you wish to get the very best results from food consumed with the least risk to health.

There is usually no profit in grinding grain for horses, unless they have poor teeth or eat rapidly, and yet the old street car system may be practical and economical when done on a large scale, if the mechanical work can be done cheaply. This method is to cut and wet the hay or straw, then mix in the ground grain. This is a very safe method and secures thorough digestion and absorption, and in addition the horses so fed are not stuffed with hay.

Feed only as much hay at one time as the horse will clean up at each feed with the grain, approximately 10 lbs. to 15 lbs. per 24 hours. Feeders are usually surprised to find how well their horses do with greatly reduced hay ration and the same grain. There is less danger from stomach and bowel troubles, and almost no danger at all from heaves.

Beware of dry bran for horses that eat hurriedly. They are liable to choke on it.

When any animal is choked do not try to force any straight and stiff object down its throat. There is great danger of rupturing the oesophagus near the pharynx.

The cow has an entirely different stomach as to its plan and size, and the intestinal canal is nearly twice as long. Her large paunch and the other stomachs, as well as the long intes-

tine, indicate that she can utilize a coarser diet than the horse, and that she can digest and absorb such foods more thoroughly. They also indicate that nature intends her to eat larger quantities at a time and at longer intervals than the horse, and that the same is true as to the water she drinks.

LECTURE XII.

URINARY ORGANS AND MAMMARY GLANDS.

Urinary organs are kidneys, ureters, bladder, urethra.

Kidneys.—These important organs are situated in the sub-lumbar regions, supported in place by large blood vessels and connective tissue. They differ in shape, size and location, the right one being larger, farther forward and more nearly round. Each is covered by a fibrous capsule from which bundles of connective tissue branch to penetrate the organ and form a framework.



FIG. 24. LENGTHWISE SECTION OF THE HORSE'S KIDNEY.
a, Cortical portion; b, medullary portion; d, d, d, pelvis; g, ureter.

Internal structure.—On cutting open a kidney we may see two distinct portions separated by a wavy line, and a cavity at the root. The two portions are cortical (outside); medullary (center).

The cavity at the root, called pelvis, is merely the funnel shaped origin of the ureter.

The arterioles terminate and the urine tubules have their origin in the cortical portion. These little urine tubes make up a large part of the bulk of the kidney. Each tubule begins somewhere in the cortical portion in a little sac like cavity, with-

in which is a tangled network of finest arterioles. The little sac narrows at the open end and from this narrowed neck continue the tubules. Each tubule makes certain convolutions, then descends to the medullary portion, thence back to the cortical where it makes certain other convolutions and finally terminates in a larger duct through which the urine escapes to the pelvis of the kidney and then into the ureter. Each tubule is thus very long in proportion to its size and there are a large number of them.

Function of the kidneys: (a) Removal of useless or waste and poisonous materials from the blood; (b) removal of normal substances from the blood when they are there in excess; (c) to keep the blood normally alkaline by removing from or adding alkaline materials to the blood as needed.

How accomplished.—The water and salts in solution are removed from the blood within the little sacs at the beginnings of the tubules by a process of filtration under pressure, the pressure on the blood, inside the fine arterioles within the urine tubule sac, being greater than the pressure on the water in the sac around the arterioles. The urea, albumen, etc., are passed out into the water farther along the tubule. These are taken from the blood by the cells which line the tubules.

Composition.—Urine is composed of water, salts of sodium, potassium, calcium, etc., together with various organic matters as urea and uric acid and various aromatic substances which give the odor. Normal reaction in herbivorous animals is alkaline. Specific gravity for horse is 1036, and for cow 1025. Either may vary within the normal range. Horse excretes about 10 pints in 24 hours, and the cow about 25 pints. Within limits the more nitrogen in feed of cow the greater amount of urine is excreted. Urine is excreted by the kidneys continuously and runs drop by drop into the bladder.

Ureters.—These are two slender tubes which conduct urine from kidneys to bladder. They are about the size of a goose quill, about one foot long and terminate at the bladder passing for an inch along between the muscular and mucous coats of that organ, before reaching the interior. This is to prevent backward flow of urine into ureters.

Bladder.—This is a muscular sac, a urine reservoir, located in the inferior and anterior part of the pelvic cavity. Ovoid in shape. This organ is supported in place by a variety of ligaments. It is in relation above, in the male, to the rectum; in the female, to the vagina and below to the floor of the pelvis. It is covered in front by peritoneum and is in relation to the coiled small intestine.

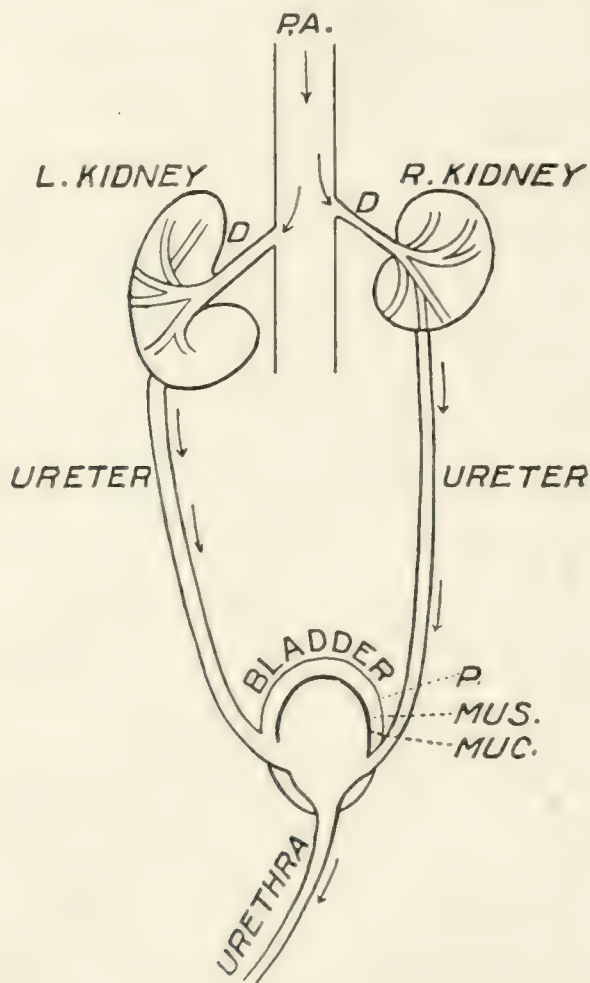


FIG. 25. URINARY APPARATUS IN DIAGRAM. (M. H. R.)

P, A, Posterior aorta; D, D, renal arteries; P, peritoneal coat of bladder; Mus., muscular coat; Muc., mucous coat.

Openings.—Three on the posterior of the organ; viz., one to the urethra, and two for the ureters. The neck of the bladder is composed of a band of yellow elastic tissue around urethra and is pulled open by longitudinal muscle fibers when urine is to be passed. No distinct sphincter or muscle fibers at the neck.

Coats.—Three: mucous, muscular (of several layers), and serous (peritoneal).

Urethra.—This is the canal which conducts urine from bladder to exterior of body.

MAMMARY GLANDS.

The cow's udder is taken as a type. The glands are located under the inguinal region and supported by skin, loose connective tissue and bands of white fibrous tissue which attach to the fibrous tunic of the abdomen and act as ligaments to help support the organ. The udder is covered by thin, soft skin and fine hair.

Anatomy.—The udder is divided into two lateral halves. Each half has two glands, front and back, and each half is encased in a fibrous sac of yellow elastic tissue.

The substance of each gland is made up of yellow glandular tissue, connective tissue, nerves, blood vessels, etc. Each gland is divided into lobes, and these again into lobules.

There is one small milk duct for each lobule. These unite into larger and larger ducts, and thus the milk is conveyed into the milk cistern.

A milk cistern is located just above the base of each teat. This receives milk from the milk ducts—capacity one pint to one quart. Milk escapes from cistern through a single large canal.

Development.—The gland structure is undeveloped and rudimentary until maturity, and only becomes active at the close of the first pregnancy.

Function.—Natural function is supplying sufficient milk to the calf until it can subsist on other foods.

Milk production.—The production of the casein, sugar, fat, etc., is a manufacturing process, not mere filtration for there is no casein or milk sugar in blood and but very little fat. Secreting cells take certain elements from the blood and put them together so as to make the milk ingredients.

Products.—*Milk* is a complex alkaline fluid; specific gravity 1018 to 1040, composed of oil globules suspended in milk plasma and is therefore an emulsion. Milk globules consist almost entirely of fat, with a thin coating of casein. They are from .0004 to .0012 of an inch in diameter. Milk plasma consists of

water, with sugar, salt, albumen and whatever may be in solution in the water.

Colostrum is a fluid which accumulates in udder during the latter part of pregnancy and differs from milk in containing the colostrum cells, a few oil globules, much albumen and but little casein, fat or sugar. It has mild cathartic effect on the young animals.

The quantity and quality of the milk depends on several factors: food, period of lactation, period of gestation, condition of the nervous system, quantity of blood passing through the udder, amount of water in the food, individual peculiarity or hereditary tendency. Breed would naturally be included under the latter.



FIG. 26. ONE QUARTER AND TEAT OF COW'S UDDER.

(O. K. C.)

C. Milk Cistern. Note constriction just below the cistern. Another constriction at end of teat. Holes, shown in the gland above, are milk ducts cut across.

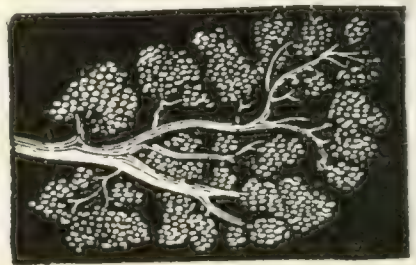


FIG. 27. MILK VESICLES AND OUTLET DUCTS. MAGNIFIED.

Blood supply.—The mammary glands receive their supply through the mammary artery, which distributes branches through the two glands in each half of the udder, one artery on each side. The blood for one-half the udder thus comes through the external iliac artery, then through a branch of that, the pre-pubic, and then through a branch of the prepubic, the external pudic.

The *mammary artery* is one of the terminal branches of the external pudic. When the cow stands still more blood flows through the udder than when she is exercising. The large vein which may be felt in front of the udder on each side and called by dairymen the "milk vein" is properly the subcutaneous abdominal vein. It does not drain the udder as popularly supposed.

Nerve supply. —The mammary glands have their nerve supply through the first lumbar pair of spinal nerves. The nerve trunk which reaches the gland on each side, divides into three branches, the second and third of which regulate in an interesting way the various phenomena of cell activity, blood supply and calibre of the milk ducts. These processes are all directly under control of the nervous system.

Why last milk drawn is richer in fat than the first: There is a comparatively small amount of milk stored in the cisterns and ducts when milking begins, and then as milking goes on the secreting cells manufacture the fat, casein, sugar, etc., more rapidly in proportion than the process by which water and matters in solution are taken from the blood and thus the later milk has less water or more solids than the first drawn.

Mare's milk differs from cow's milk in possessing more fat and sugar, and less protein. Her udder differs from the cow's udder in having but one gland in each half. There are from two to four cisterns at the base of the teat instead of one and each cistern has an excretory canal to the point of the teat.

LECTURE XIII.

THE FOOT.

The foot, technically includes all structures at and below the knee in front, and the hock behind. This lecture only deals with that portion of the foot below the ankle.

Bones.—First phalanx; two sesamoid bones; second phalanx; navicular bone; and third phalanx. For first and second phalanges, sesamoids and navicular, see Lecture III.

The *third phalanx* is an irregular bone of loose spongy texture. The body is shaped somewhat like the hoof and shows at the top in front a prominence called the pyramidal process, and on each side a projection called the wing, under which may be seen a groove through which groove an artery passes on its way to form part of an arch within the substance of the bone. From this arch is given off the branches which distribute nourishment to the vascular parts. Above the wings, inside the hoof, are cavities into which the lateral cartilages fit. They are of firm cartilage and may be felt above the crown of the hoof on each side. They are attached below to the wings of the third phalanx and plantar cushion. To the front and sides of the third phalanx are attached the sensitive laminae. The inferior surface is concaved to receive the sensitive sole, or velvety tissue.



FIG. 28. BONES OF THE HORSE'S FOOT.

1, Metacarpal; 2, 2, sesamoids; 3, first phalanx; 4, second phalanx; 5, navicular bone; 6, third phalanx (os pedis); 7, basilar process; 8, 8, wings; 9, pyramidal process.

The *navicular bone* is also a sesamoid bone; i. e., it is formed in tendon. It is a short bone in structure, but rather long and slender in shape, and placed crosswise just back of the articulation between the second and third phalanges. Its inferior surface is smooth except for a slight ridge in the center. The tendon of the deep flexor muscle passes over this surface on its way to its insertion on the bottom of the third phalanx. The ends of the navicular bone unite on each side with the wings of the third phalanx by tough fibrous tissue.

The horny hoof.—This is to be regarded as an appendage of the skin. It covers all of the third phalanx and part of the second. It is divided for study into wall, sole, and frog.

The *wall* is that part which may be seen when looking at the hoof in front and at the sides. It is composed of horny, tubular fibers, which grow from the coronary band. Between these tubular fibers is a material which holds them together. The wall is divided into toe, quarters, and heels. At the top is a groove into which the coronary band fits, the crown of the hoof. The wall unites below with the sole. The smooth shining layer which should cover the whole surface of the wall is periople. The duty of this layer is to prevent undue evaporation from the hoof. Beneath the periople is the horny wall which gives shape to the foot and protects the soft parts within. Inside this hard layer come the laminae, 500 to 500 thin leaves of horny material which dovetail in with the sensitive laminae.

The *sole* is composed of horny material resembling that of the wall. It is concave below, convex above. Its outer border unites with the wall at the "white line." Its upper surface is covered by the vascular velvety tissue.

The *frog* is a "V" shaped elastic pad with a depression, called by horsemen "the cleft," in its ground surface. It is located between the bars on each side, and below the plantar cushion. Its function is to act as a pad and to lessen jar when traveling.

The matrix (horn generating membrane).—This fits inside the horny part of the hoof and covers like a stocking the other parts within the hoof. It is from this that all the horny parts grow. It is composed of three parts: (1) coronary band; (2) sensitive laminae; (3) velvety tissue.

The *coronary band* is the elastic ring that may be felt at

the crown of the hoof. It is studded with little papillae. From these grow downward the tubular fibers which make up the hard layer of the wall.

The *sensitive laminae* are 500 to 600 layers of vascular tissue into which fit and from which grow the horny laminae of the wall. An inflammation here is called laminitis or founder.

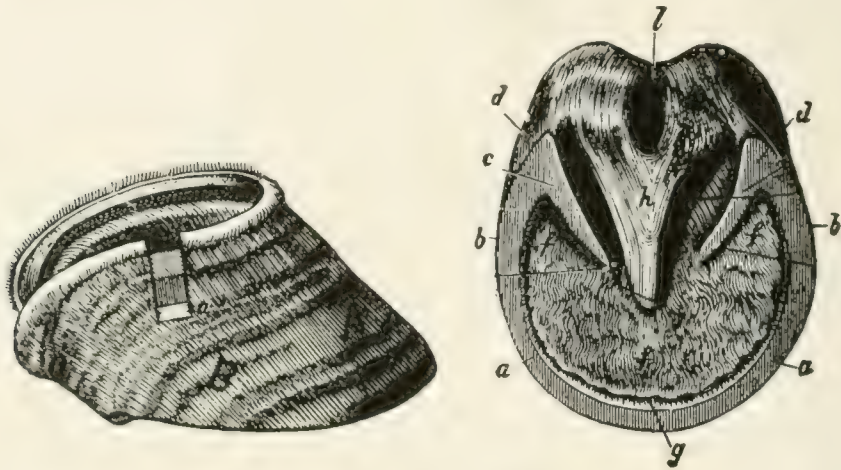


FIG. 29. THE HOOF.

The Wall. A, Toe; B, quarter; C, heel.

Ground Surface. a-a, Toe; a-b, quarter; b-d, heel; c, bar; f, f, f, sole; g, white line; h, frog; i, cleft of the frog.

The *velvety tissue* covers the upper surface of the hard sole. Like the coronary band and sensitive laminae, it is sensitive and richly supplied with blood. The under surface is thickly studded with papillae, similar to those of the coronary band, and from these in a similar way grow the shorter tubular fibers which make up the hard sole and frog. The student can easily understand why injury to the coronary band, which results in a healing by scar tissue, leaves a split which lengthens downward in the hoof; why founder is so painful; and why deep injuries to the sole are so apt to be serious.

The *plantar cushion* is a wedge-shaped mass of elastic tissue located between the lateral cartilages on each side, below the sole of the third phalanx and above the horny sole of the hoof. It assists the horny frog in lessening jar in travel and protects the insertion of the deep flexor tendon.

"The back tendons" is a term used by horsemen to include the tendons of the superficial and deep flexor muscles of the foot and the suspensory ligament.

The *superficial flexor muscle*, of the front foot, has its origin on the lower end of the humerus and its insertion by tendon on the sides of the second phalanx. Its function is to flex the foot at the first interphalangeal articulation.

The *deep flexor muscle*, of the front foot, has its origin in common with the superficial flexor on the lower end of the humerus, and its insertion by a tendon which spreads out on the sole of the third phalanx. Its duty is to flex the second and to assist in flexing the first interphalangeal articulation.

The *suspensory ligament* is broad and very strong. It attaches by its upper end to the carpal bones and to the large metacarpal. Its lower end divides into two branches which pass forward on each side and attach to the front tendon. Its duty is to support the metacarpo-phalangeal articulation (fetlock).

GOOD FEET.



FIG. 30. THE HOOF MATRIX.
1, Periople ring; 2, coronary band; 3, sensitive laminae; 4, heel. Velvety tissue not shown on the sole.

The shape and peculiar characteristics of each hoof correspond in correlation with the remainder of the limb, except as the hoof has been varied by artificial means. So in judging the hoof it is also necessary to consider the characteristics of the entire limb.

The front limb may be said to be normal in position and direction when it appears on front view that a vertical line from the front of the scapulo-humeral articulation passes down the center of the limb and to the ground at the center of the toe.

On viewing such a limb from the side it should be evident that a vertical line downward from the bony prominence at the middle of the scapula would divide the external surface of the limb into two equal portions and reach the ground immediately back of the heels.

Viewing the hoof and pastern alone it should be seen that the hoof is in direct line with the pastern and metacarpal or metatarsal bones, and that a line extending from the center of

the cannon through the center of the pastern would pass through the center of the toe.

The hind limb when viewed from behind should show that a vertical line downward from the prominence at the posterior portion of the pelvis on each side (tuberosity of the ischium) would divide the entire limb into two equal portions and reach the ground back of the center of the horny frog.

Viewed from the side the normal hind limb should indicate that a vertical line, dropped from the prominence of the articulation between the femur and pelvis, should reach the ground opposite a point near the center of the hoof. This line is somewhat difficult to get, and of less value for the reason that a slight leaning forward or backward disturbs it. This should be taken when the horse is standing with the limb squarely under the body in a natural position for the particular animal examined.

For the front hoof the wall at the toe and the anterior surface of the pastern, should make an *angle* of not less than 45 nor more than 50 degrees with the level ground surface. The wall at the toe and the anterior surface of the pastern having the same slant.

For a normal hind hoof the *angle* should be from 50 to 55 degrees, and the anterior faces of the hoof and pastern should still have the same slant.

A normal hoof has a good quality of horn, wide *heels*, and circular rather than long and narrow ground surface. The hind hoof is narrower and more pointed at the toe than the front hoof. The *wall* from coronary band to ground surface should be straight and smooth; i. e., no ridges or grooves. The *heels* should be rounded, well developed and of the same height at the top of the coronary band. The *sole* should be distinctly concave and show no marked separation from the wall. The *frog* should be large, elastic, the two portions of the same size, with a shallow groove along the center. The *bars* should be straight, extending forward and inward. The *lateral cartilages*, felt above the coronary band on each side, should be elastic. The sole in the angles between the bar and wall at the heel should not show red stain. There should be no separation of the horny fibers as in toe or quarter cracks. The wall should be reasonably thick. This can be usually determined by tapping the wall with a hammer, noticing its rigidity.

LECTURE XIV.

PATHOLOGY.

Physiology is the study of the body organs and their functions in health.

Pathology is the study of diseased organs and their disordered functions. Healthy conditions are taken as a basis for studying the diseased conditions. Pathological processes are but healthy ones modified.

HYPERAEMIA—CONGESTION.

There are two kinds of hyperaemia, active and passive.

In *active hyperaemia* there is excess of blood in the arteries of some tissue or organ. This condition may be due to excessive strength and activity of the heart and want of strength and elasticity in the arteries of that part, allowing them to stretch.

Passive (venous or mechanical) *hyperaemia* is a condition in which the current of blood is slowed and there is excess of blood in veins and capillaries. The condition may be due to weakened heart action or to obstruction in arteries or capillaries. The local changes that may follow passive congestion are exudation of plasma with some red and white corpuscles, and later gangrene. An active hyperaemia, on the other hand, may lead if long continued to enlargement of the part or organ. The vessels themselves may enlarge to several times their former size.

INFLAMMATION.

Definition. —A pathological process, marked by pain, heat, redness and swelling. These are called the cardinal symptoms.

The changes which occur during inflammation are: (1) dilatation of arteries and veins; (2) current velocity increased at first, then decreased; (3) when current begins to decrease the corpuscles collect in capillaries and small veins and adhere to

their walls, thus obstructing the blood current; (4) both kinds of corpuscles and the blood plasma may pass through walls of small veins and capillaries. Inflamed tissue may lose vitality, degenerate and die.

Inflammation varies according to (a) resisting power of tissue, (b) activity of cause, (c) length of time cause is in action.

Causes of inflammation.—Are: (1) Mechanical injury, chemical action, excessive functional activity, extremes of heat and cold, etc. Inflammation thus caused has little tendency to spread beyond the part injured, and there is usually little or no pus unless pus germs invade the inflamed area.

(2) Microbes, micro-organisms and germs are synonymous terms as commonly used. These can cause inflammation without the aid of local injury. Inflammation may be caused directly by their mechanical presence and activity, or it may appear as the result of irritation caused by chemical agents which the germs manufacture. Microbic inflammation may be either septic or infective.

Terminations.—Inflammation may terminate in (a) resolution, (b) death of the tissue, or (c) new growths.

Resolution.—In this case the exudate is removed by the lymphatics and veins; blood current starts again in the small vessels; the corpuscles move away in the re-established current or else become degenerated like the fibrin of the exudate and then removed, and the organ or tissue becomes normal again.

Local death.—If death of the part occurs, the inflammation goes on until part or all of the inflamed organ or tissue dies.

If new growths occur, there develop new tissues, e. g., tumors, granulations in wound, and scar tissue.

FEVER.

Definition.—Fever is a pathological condition characterized by an excess of heat in the body. Not a disease, merely a symptom of disease.

Cause.—Any disturbance that causes an increase of heat production or decrease of heat loss, usually the former. Normal temperature of horse is 100 degrees F. to 101.5 degrees F. One hundred and four degrees F. is called high, 106 degrees F. very

high. Normal temperature of adult cattle varies from 100 to 102.5 degrees; of sheep from 100 to 104 degrees. Nervous system has control of both heat production and heat loss. The body temperature is therefore a balance or relation between heat production and heat loss.

Heat production.—The source of animal heat is the oxidation of body tissue and fuel materials in the blood and the consequent breaking up of complex chemical compounds into simpler ones. The principal heat furnishing organs are the muscles and secreting glands.

Heat expenditure.—Body heat is normally expended about as follows: warming food and drink, 2%; warming air in lungs, 5%; evaporation from lungs, 8%; evaporation of moisture from the skin surface and radiation from skin, 85%. The expenditure of heat in evaporation of moisture from the skin surface is very much larger than either of the others. On an average there is sufficient heat developed daily in a body of a medium sized horse to raise 4,550 gallons of water 1.8 degrees F.

Symptoms of fever.—(a) Elevation of temperature; (b) dry, hot skin (not always present); (c) pulse and respiration quickened (normal pulse of horse, 36 to 45; normal respiration 8 to 14 per minute); (d) scanty urine; (e) loss of flesh.

Kinds of fever.—Classified according to course are: (a) *continuous*, with but slight variation; (b) *remittent*, varies greatly during the day, but does not get down to normal; (c) *intermittent*, in which the temperature varies at different portions of the day and reaches normal at a certain time each day; (d) *relapsing*, fever comes at certain intervals, with a period of one or more days of normal temperature between.

Stages of fever.—(a) The initial, or beginning; (b) the acme or highest point; (c) decline. The initial stage may be either short or long, according to the patient and disease. The decline may be slow or rapid.

Results.—(a) Emaciation, or general atrophy, more or less severe, according to the duration and height of the fever, and caused by continued unusual oxidation of body tissues; (b) death may occur, or; (c) recovery. Death may occur suddenly, or the final changes may occur gradually. The recovery may be par-

tial or complete, slow or rapid, depending on: the nature of the disease of which the fever is a symptom or condition; the native vigor or vital constitution of the patient; and the conditions under which the patient is kept and under which the disease runs its course.

LECTURE XV.

PATHOLOGY.

Haemorrhage is any appearance of blood outside of the natural channels.

Causes.—(1) Injury to the vessel walls, as when cut or torn; (2) diseases of the vessel walls, e. g., fatty or calcareous degeneration; (3) excessive blood pressure inside the vessel, as in hypertrophy of the heart with excessive strength and activity resulting in rupture of the vessels; (4) change in the quality of the blood with weakness in the vessel walls.

Dropsy is any abnormal collection of serous fluid in any cavity or tissue of the body. This may occur in the abdominal cavity, in the chest cavity, ventricles of the brain, or in loose tissues under the skin. Of those places outside the large cavities, the most common are the limbs and lower portions of abdomen. Dropsical fluid is usually of pale straw color, nearly neutral in chemical reaction and slightly heavier than water.

Cause of dropsy.—(1) Any local increase of blood pressure, (2) any interference with flow of blood in the veins, (3) obstruction in capillaries, which is quite common in diseases of the liver.

Dropsy may be either general or local.

General dropsy may affect the sub-cutaneous connective tissue over a large area, and any of the serous body cavities. It may be due to conditions associated with anaemia, heart trouble, or kidney disease.

Local dropsy is limited to some one organ or cavity, and may be due to local mechanical obstruction in the veins or may occur as a result of inflammation, as in pleurisy where there is an inflammation of the pleura and dropsy into the pleural sacs.

Hypertrophy is any enlargement of any part or organ of the body. It may be due to either an increase in the number of elements, or an increase in the size of existing elements, or to a combination of two conditions. Hypertrophy may be either physiological, healthy, or pathological, diseased.

Physiological hypertrophy is illustrated in the blacksmith's arm, where there is an enlargement due to an increased exercise and therefore increased nutrition to the muscles. If one kidney be removed, the other enlarges to compensate.

Pathological hypertrophy is illustrated in fatty degeneration of the heart, in which this organ undergoes fatty changes and becomes larger, but loses in strength and usefulness.

In any hypertrophy the newly formed elements are more nearly like the normal when the circulation is most vigorous.

Atrophy is the opposite of hypertrophy and is characterized by a decrease in bulk and weight, as for instance seen of the shoulder muscles in horses. Atrophy may be general or local and the decrease in size may be due either to decrease in size or number, or to decrease both in size and number of the elements.

Local atrophy may be caused by: (1) decreased amount of blood and decreased nutrition, (2) nerve disturbance which sometimes results in very rapid atrophy, (3) inflammation; (4) excessive functional activity and exhaustion of the tissue elements; (5) continuous pressure.

General atrophy may be caused by lack of nutrition or excessive consumption and wastages of the soft tissues, especially the fats which are first taken; e. g., in typhoid fever in the human, or influenza in the horse.

Degenerations and infiltrations are characterized by changes in the quality of a tissue; the bulk may or may not remain the same. When tissue degenerates, cheaper material may be deposited in and actually becomes a part of the tissue. This is degeneration. When infiltration occurs, the lower grade tissue is deposited between the fibers or tissue elements, whatever these may be. The proper elements may then shrink. The tissue or organ loses in functional strength and activity in either case.

Fatty degeneration is characterized by a deposit of fatty matter into and as a part of the tissue elements, especially common in muscular tissue.

Fatty infiltration is characterized by a deposit of fatty matter between the elements according to the previous definition. Either may be caused by (1) deficiency of blood and consequent

imperfect nutrition; (2) inflammation; (3) high fever; (4) poisons like phosphorus, arsenic, antimony, etc.

Calcareous degeneration and infiltration are marked by deposit of lime salts into or between the tissue elements and may be caused by anything that results in imperfect nutrition and lessened vitality. These conditions occur more frequently in the tissues of older people or animals. The muscular coat of the arteries sometimes becomes calcified and brittle in old people and may even break under some unusual strain.

There are various other degenerations and infiltrations besides these two named; but in each case there occurs the deposit of some inferior tissue into or between the proper elements of the organ.

Collapse.—The symptoms are: temperature below normal; surface of body cold; respirations very shallow and slow; pulse feeble and very slow or very fast.

Collapse may be the result of (a) a very high fever, (b) poison, (c) suppression of secretion or excretion, (d) rupture of internal organs, (e) excessive haemorrhages, (f) decomposition of the blood.

Syncope is nearly the same as collapse, except more sudden and the symptoms are very brief.

Death begins at heart, lungs or brain. Heart failure (syncope) is very sudden. Lung failure results in suffocation or asphyxia. Brain failures develop slow symptoms, stupor being present. When death occurs because the blood is altered, the heart first ceases action.

LECTURE XVI.

WOUNDS.

Definition.—A sudden break in the continuity of a tissue, caused by external violence. Wounds are usually open, sometimes subcutaneous.

Healing.—All wounds heal by the production of new cells and new intercellular substance formed from preexisting tissue cells. These constitute granulation tissue. The embryonic cells change later into mature cells like those of the adjacent tissue. Complete union implies a restoration of circulation and nutrition. This again implies new blood vessels for the new tissue.

Union by primary intention.—The essentials of this mode are rapid union and absence of pus. All wounds which heal without suppuration heal in this way. There is always some new tissue, although it may not be visible.

By granulation.—The new cells are formed by the division of preexisting cells. All wounds heal only after the development of more or less granulation tissue between the divided surfaces. If the wound is free from germs and the surfaces are kept at rest and close together, healing is very rapid and but little new tissue needed. Where there is loss of much tissue, it may be impossible to bring the surfaces together and a great deal of new tissue is needed. Connective tissue cells only develop from preexisting connective tissue cells, epithelial from epithelial, bony from bony, etc.

When wounds are covered with granulations, each little elevation contains a loop or network of new blood vessels. The white blood corpuscles emigrate through the new blood vessels and form part of the pus when this is present. Healthy granulations are small, firm, pink in color, and the surface around them is slightly moistened with a colorless fluid. In this case the wound heals rapidly and usually leaves a small scar.

Proud flesh is merely a mass of profuse granulations, and

indicates either a lack of vitality in the system or else external irritation. The latter is usually from germs.

Development of new blood vessels.—This is from vessels that previously existed in the injured tissue. The growth of new blood vessels and new tissue for union, start together and continue until enough granulation tissue has been developed. After the embryo cells have become fully developed unnecessary vessels begin to disappear. The new vessels start by budding from capillaries near the surface and are always short. These buds project farther and farther and gradually change into threads. These gradually hollow into tubes beginning at the end near the old capillary. It happens frequently that the ends of two neighboring projections meet and unite to form an arch. After this becomes hollowed out we have a capillary loop formed. When this development is complete, then new blood vessels may start out from this one and perhaps develop another arch. The thread-like projections are probably hollowed out by the blood current in the parent vessel.

Inflammation in wounds is due to foreign material; for instance, dead tissue or foreign bodies, but more commonly by germs which by multiplication give rise to wound infection and inflammation.

Osseous tissue.—Wounds in bone tissue heal like those in other tissues, the wound surface being covered with granulations. The development of new tissue is from the periosteum and from the marrow at the **place** of injury. At the end of a few weeks, the ends are united by a spongy mass beneath the periosteum and in the medullary canal. This mass gradually becomes organized. This is called a callus and is largely removed later.

Cartilage has very little power of repair. Loss of cartilage is generally repaired by connective tissue.

Nerve tissue.—After a nerve is cut, the distal end degenerates. New axis cylinders come down from the proximal portion and grow through or along old sheaths of the distal end. It is doubtful whether primary union ever takes place. Quick return of sensibility does not necessarily imply restoration of the injured fibers. The proximal axis cylinders enlarge and separate at the ends. As they grow in length they may extend out into surrounding connective tissue, the proximal end of the nerve

has then changed to a mass of fibers distributed through the surrounding connective tissue. The axis cylinders receive new sheaths which probably grow from nerve cells lying within the old sheaths. Whether the new fibers ever reach the old terminals, depends upon the amount of intervening tissue and the density of it. The limit of growth is placed at from one to two inches.

The new tissue.—In certain tissues, extensive injuries may be repaired by tissue which completely resembles the original. This is true of tendons and bones. Muscular tissue seems to have much less ability to repair extensive injuries. Scar tissue contracts for a long time after healing is complete. The scar is large when there has been more granulation tissue than needed or where an extensive removal of tissue necessitates a great amount of scar tissue. Scar tissue in this case is endowed with low vitality, and is poorly nourished.

How skin recovers a surface.—A wound is not entirely healed until it is recovered. This takes place by development of new epithelial cells from preexisting ones of the skin. These new epithelial cells gradually form new skin which grows from the margin and has a slight bluish pink color. It only covers the granulations loosely at first, but later unites firmly to them. New epithelial cells have the power of amoeboid movement. They may become detached from the margin and set up a new covering center elsewhere on the wound surface. Restoration of the skin surfaces and for that matter the entire healing is favored by surgical cleanliness, and is hindered by irritating medicines, and by rubbing sponges, etc., over the surface.

An exception should be noted, viz., that when healing has ceased in case of an old sore, with the surface not yet covered by skin, healing may sometimes be given a vigorous start by a blister.

LECTURE XVII.

WOUNDS.

The most common wounds which affect stock are those caused by barbed wires, plows, harrows, etc., and are generally large and badly torn. The farmer rarely has to deal with a nice clean wound that can unite smoothly and heal rapidly.

Bad treatment.—Nearly every farmer has some special preparation which he thinks of great value in the treatment of wounds. Most of these preparations are seriously injurious, and greatly retard healing. Various preparations of turpentine, alcohol, vinegar, carbolic acid, irritating oils, and even the mineral acids are frequently used in the treatment of these wounds and then because the patient recovers in spite of barbarous treatment, people erroneously conclude that the medicine cured.

Bleeding.—This can usually be checked quite easily. If the blood comes from a large number of small vessels the haemorrhage can be checked and finally stopped by means of ice, by very cold or very warm water, or the wound may be packed with clean cotton or oakum and tightly bandaged. In case a large blood vessel is severed, it may be better to draw the end out and tie a strong thread around it. The artery may be secured by means of small forceps or even with a hook made by bending a pin or piece of wire.

In some cases haemorrhage can be easily controlled by a tight bandage placed above or below the wound. If the blood flows in a steady stream the bandage should be on the side farthest from the heart. If it flows in jets the bandage should be tied between the wound and the heart.

Sewing.—Comparatively few wounds are materially benefited by sewing, bandaging or washing except in professional hands. If the wound is made lengthwise of the muscle there may be considerable advantage in holding the sides together by sewing. No special form of needle or thread is necessary except that both should be clean, and the latter should be of rea-

sonable size. A darning needle and ordinary white cotton thread or twine will do very well in an emergency. But if the wound is made across the muscle and gaps widely, it is usually unwise to sew, for the sutures will cut out in a few days and make the scar much worse than if it had been left alone.

Bandaging.—Occasionally a wound is such that the edges can be held together by means of bandages. If this can be done, there may be considerable advantage in so doing, but these wounds are rare. Bandages must be changed frequently and the wound kept clean.

Washing.—Few of these wounds are benefited by washing or other external treatment. If a wound is such that pus can drain from it freely and as rapidly as formed, there is little to be gained by washing. If on the contrary there are deep recesses or pockets from which the pus cannot drain, then the wound must be so altered that these pockets will drain or else they must be washed out, otherwise the pus may burrow deeper.

Carbolic acid is commonly used so dilute that it is without effect. When used strong enough to be distinctly antiseptic it becomes injurious to the wound surface. If washing is necessary, use warm water containing a trace of salt, just enough salt so that it can be tasted. This is efficient and not injurious. In any case the wound surface must not be rubbed over during the process of washing.

Dry treatment.—Sometimes quicker and better results can be obtained by the use of nonirritating and stringent antiseptic powder; for instance, the following: iodoform, boracic acid, and tannic acid, in equal parts. This may be dusted over the surface once daily to produce an artificial scab.



FIG. 31. BADLY TREATED WIRE WOUND. (M. H. R.)

Maggots.—This trouble can usually be prevented in small wounds by smearing the following mixture around the border: turpentine 1 part, tar 3 parts, fish oil 2 parts. If a wound becomes infested with maggots use chloroform. This may be applied either by spraying or by throwing it in small drops from a sponge.

Suggestions.—Wounds frequently heal more rapidly and perfectly in open air than in the stable, because there is more ammonia in the air of the stable, and injurious germs are more abundant. Healing of some wounds is retarded by exercise and such patients should be kept in the stable.

LECTURE XVIII.

CAUSES AND PREVENTION OF DISEASE.

CONTAGIUM.

Definition.—Living germs which constitute the specific and primary cause of certain diseases and which may be transmitted from one animal to another. An outbreak of disease may be *enzootic* (local), or *epizootic* (widely spread).

Description.—Bacteria are vegetable microorganisms. Each individual consists of a single cell. They are of almost infinite number of species and varieties, and are present in the atmosphere in particles of room dust; in drinking water; in the soil and in fact, almost everywhere in great abundance.

Size.—They are extremely small, requiring the highest powers of the microscope to make them distinctly visible. It is estimated that millions may live comfortably in a single drop of fluid. An average bacillus is from 1-25000 to 2-25000 of an inch long.

Motion.—Some of these little plants have positive motility, others have no true motility; many of them have a peculiar dancing motion (Brownian motion).

Nutrition.—Bacteria use for their food, the chemical elements, oxygen, nitrogen, carbon, hydrogen, phosphorous, and sulphur. Like higher beings, they vary in their likes and dislikes. What is wholesome for one may be very injurious to another. Each species has its certain conditions of moisture, temperature and chemical reaction which are most favorable.

Reproduction.—These little beings reproduce by fission and by spore formation. If the fission is incomplete they remain in chains. The spore is the hardy resistant form and corresponds imperfectly to seed formation of higher plants. It is estimated that one individual may increase to 1,176,570 in 10 hours.

Plagues in history.—Throughout all the pages of history, we have records of fearful plagues among men and animals. About 1500 years before Christ a great plague of murrain swept through Egypt and made a great slaughter of cattle. We are

told concerning the plague at Athens, 430 B. C., that dead men, dead animals, and dead birds lay in piles on the streets, and even the temple floors were covered with bodies.

Plagues recur at intervals through the history of the city of Rome. About 453 B. C. an outbreak, possibly anthrax, destroyed nearly one-half the population of Rome, as well as their cattle, and the outbreak spread extensively through what is now Italy. A widespread outbreak of anthrax occurred in France and Belgium, 591 A. D. This same disease is said to have spread all over Europe again about 1750. Cattle plague was carried into England in 1745, and the loss was very heavy. This outbreak lasted for several years in various parts of Europe, and the loss cannot be estimated. Tuberculosis has long been prevalent. These are all contagious diseases and are caused by bacteria. The above are but isolated examples of an indefinite number of outbreaks of various diseases which have appeared among domestic animals.

How scattered. —Germs of diseases are scattered by a very great many agencies, for instance, the germs of hog cholera are disseminated by means of the diseased carcasses, hog racks, stock cars, and they may be easily transferred by the shoes or clothing of persons who walk through an infected yard. Dogs undoubtedly serve to scatter this disease over wide areas, and possibly birds. It is possible, also, for the germs to be scattered upon particles of dust and litter in high winds. Watering troughs, tanks, ponds and sluggish streams are all common sources for spreading infectious diseases.

Development of outbreaks. —It seems to be true of several, and possibly so of a great many diseases, that the germs may be present with the animal or his surroundings but not virulent enough to produce disease. Under favorable conditions and perhaps after passing through the bodies of several susceptible animals in succession they may increase in virulence sufficiently to produce disease.

Some of the germs producing diseases of domestic animals are believed to live for very long periods of time and possibly even vegetate outside the animal body, possibly upon or within the tissues of plants. Some germs, especially in the resisting or spore stage, may live for very long periods of time, and under very

unfavorable conditions retain virulence. For example, the spores of anthrax.

Some outbreaks of infectious diseases appear very suddenly, with the most virulent and rapidly fatal cases appearing earliest in the outbreak. The outbreak then gradually loses virulence, the last cases being of a decidedly chronic nature, and some of them possibly recovering. This is frequently illustrated in hog cholera. It is possible, however, that before the virulent form was noticed, that there may have been a series of very mild cases, the animals not being appreciably sick, but the germs in passing through susceptible bodies greatly increased in virulence until they were able to produce a rapidly fatal type of the disease.

● COCCACEÆ

■ BACTERIACEÆ

~ SPIRILLACEÆ TYPES
~

FIG. 32. GENERAL GROUPS OF BACTERIA. DIAGRAMMATIC. (M. H. R.)

Body entrance.—Germs gain entrance through the respiratory organs with the inspired air; through the digestive organs; through cuts or scratches in the skin and mucous membranes, and rarely infection occurs before birth.

Method of injury.—Germs cause injury and disease in at least two different ways, *first*, by rapid multiplication, and mechanical presence in inconceivable numbers. As an example of disease caused by germs in this way, at least partly by mechanical presence, we have actinomycosis (lumpy jaw). *Second*, germs which by chemical action may produce intensely poisonous substances in the blood and body tissues. As an example of this we have tetanus and diphtheria.

How destroyed in nature.—Nature disposes of disease germs in a variety of ways, principally by oxidation, by the devitalizing effect of sunlight, and they are scattered over wide areas and enormously diluted by the wind and water.

Classification.—Germs are classified into general families according to form, multiplication, presence or absence of sheath

and whether motile or not. There are at least three general family types of bacteria: Coccaceae, Bacteriaceae, and Spirillaceae. Two of these general groups (coccaceae, and bacteriaceae) contain most of the species that are known to cause diseases of domestic animals.

First, *Coccaceae*.—These are spherical. They multiply in from one to three different planes and are grouped accordingly in chains; in masses extending in two directions; and in masses extending in three directions. Under the microscope these little germs appear as round dots. A great many of the most common diseases are caused by germs which belong to this general family. For instance, erysipelas and various types of blood poisoning, abscesses and sloughing.

Second, *Bacteriaceae*.—These are short rod-shaped germs, and include two especially important genera, *Bacillus* and *Bacterium*. Among the common diseases of live stock, which are caused by germs belonging to this general family, there may be given as illustrations tuberculosis, hog cholera, swine plague, glanders, tetanus (lock jaw, and haemorrhagic septicaemia.

Third, *Spirillaceae*.—This group is not especially important in veterinary medicine. The individuals are rod shaped, curved or spiril and may be very short or very long. The specific cause of Asiatic fever (human) belongs in this general group.

LECTURE XIX.

DISINFECTION.

Purpose.—In veterinary practice, disinfection is intended to check the spread of infectious diseases, and to protect from further infection animals which may be already diseased.

Sources of infection.—In any process of disinfection it is important to know something concerning the nature of the infecting germ, and the sources from which it comes. Germs of diseases are spread in a great variety of ways. For instance, with the body fluids of sick animals; by soiled water or food or by any contaminated matter. Air may be contaminated from the skin and lungs of diseased animals. The soil may be contaminated by the burial of diseased animals or by the deposit of any infectious material upon the surface. In any such case, germs may be washed to ponds, sluggish streams or shallow wells thus contaminating the water. Hides, offal, and even the hair of a diseased animal may be a source of spreading disease. Railway stooed may be disinfected by having straw burned over it, and for safety should be removed to a depth of at least six inches and replaced with fresh earth. Paved flooring may be disinfected by burning over it any inflammable material. Cracks should be disinfected by free use of corrosive sublimate solution. Food which may have been contaminated should ordinarily be destroyed, but in some cases such food may be given to non-susceptible animals. Drinking places should be disinfected, also curry combs, brushes and everything of that sort.

Must be thorough.—Disinfection is not reliable and should not be depended upon unless done most thoroughly.

Attendants.—Attendants for sick animals should be very careful about their clothing, particularly trousers and shoes. It is well to use special overalls and overshoes which should be left at the infected stall or building.

Dogs, rats and any of the smaller animals which are liable to convey the disease should be guarded against.

"How to Burn a Carcass."*— Dig a cross-shaped trench about nine inches deep in the center, becoming shallow toward the edges; about seven feet long each way, and 9 or 10 inches deep. The earth is thrown in the angles; two bars of iron are placed across for a bridge and upon them the fuel is placed. The trunk of the carcass is placed upon the fuel, then another layer of fuel, then the internal organs, and limbs of the carcass, and finally another layer of wood. The cross-shaped trench gives a draft—no matter which way the wind may be blowing.

DISINFECTANTS.

Alcohol.—This is considered unreliable, not strong enough in its germ destroying properties, but useful for certain purposes, particularly as an aid in disinfecting greasy surfaces.

Carbolic acid.—Pure carbolic acid is usually seen in the form of light colored crystals, sometimes slightly red. As sold in the drug stores it is usually liquified by the addition of 5 to 8 per cent of water. It is soluble in water up to about 6 per cent. This is one of the most commonly used and most reliable disinfectants. It is objectionable in being quite poisonous; but it does not destroy clothing or corrode metals like corrosive sublimate. The best antidote is probably alcohol for internal poisoning or for external burns. Alcohol may be given in large doses for this purpose. For disinfection, use as 5% solution.

Crude carbolic acid was formerly a very valuable disinfectant, and cheap, but it has fallen into discredit because some of that put on the market in later years has been robbed of its disinfecting properties in the manufacture of various proprietary disinfectants.

Creolin.—This is supposed to be a combination of crude carbolic acid with soap. It is a dark brown, rather thick liquid, and makes a milky emulsion with water, used in 5 to 10 per cent solution.

Formalin.—A very important disinfectant, either as a liquid or when vaporized. It is in the market as a 40 per cent solution of formaldehyde gas. The odor is very irritating and disagreeable, resembling somewhat chlorine. Formalin is apparently more active in the presence of moisture. For use in vapor form, at

*Method recommended by Dr. F. Smith.

least 20 ounces per 1,000 cubic feet, should be introduced rapidly into a tight room. Glycerine or borax should be added in the retort.

Fire.—The most reliable disinfectant, and the one that should be invariably used where an article may be destroyed.

Moist heat.—More active and reliable than dry heat at same temperature. Boiling temperature for an hour will probably destroy any known disease germs, including spores, although the spores of several nonpathogenic organisms resist much longer. It has the further advantage of not destroying the article disinfected.

Corrosive sublimate.—This is sold in the form of white crystals or powder. It dissolves in about 16 parts of water and its solubility can be increased by alcohol, muratic acid or iodide of potash. It is disinfectant in the proportion of 1 to 2000 (about $3\frac{1}{2}$ grains to a pint of water) and destroys germs in even more dilute solution. A very convenient solution can be made by dissolving it in alcohol in the proportion of 1 to 8, then a teaspoonful of this to a quart of water gives a 1 to 2000 solution. It should be borne in mind that corrosive sublimate is dangerously poisonous; that it coagulates albumin, and corrodes and destroys metals.

Sulphur.—This agent, when burned, has long been used for disinfectant purposes, but is probably not as valuable as is generally supposed. If a very large quantity of sulphur is used, after the surfaces to be disinfected have been moistened by steam or otherwise and doors and windows kept tightly closed for a long period of time, then it seems to have more decided germ destroying properties. There is needed about 10 pounds per 1000 cubic feet of air. This may be easily burned by the addition of about three or four ounces of alcohol, the whole being placed in an iron kettle, and that in a tub of boiling water, partly for safety and partly for moisture. The interior of a building can be fairly well moistened by throwing heated stones or irons into tubs of boiling water, or by force pump, hose and spray nozzle.

Sunshine.—Destroys germs. Whenever sufficient time may be had, infected clothing or any article to be disinfected, especially where the infection is on the surface, can be rendered safe by long exposure to sunshine.

LECTURE XX.

CAUSES AND PREVENTION OF DISEASE.

HEREDITY.

Definition.—The great law of inheritance that “like tends to produce like.” This tendency may apply to any peculiarity. Heredity may appear as a factor in the cause of disease when actual disease germs are transmitted, which is probably rare, or when a local weakness, general susceptibility, appears, which is favorable to the development of disease.

Theory.—The modern idea of heredity in relation to disease is that the thing actually inherited is usually only a tendency or a lessened resistance. This may refer to the white corpuscles and serum of the blood as well as to muscle and tendon or bone cells.

This theory of lessened resistance applies to spavins, bad eyes and certain internal diseases alike. Under favorable conditions the actual development of disease may not occur.

A stallion with defective eyes is apt to sire colts with bad eyes. Mares with curby or spavined hocks are apt to raise colts with bad hocks. In rare cases the young is born with the actual disease present.

The suggestion is obvious. Breed from naturally sound animals, and it should be borne in mind that a fat animal is not necessarily a sound or healthy animal. Domestic animals in show condition may be diseased either internally or externally.

In and in breeding.—This frequently tends toward physical decay, infertility, tendency to abortion and various diseases of lungs and eyes. In human family it tends toward idiocy, freaks, consumption and a variety of diseases. Statistics are meager but essential facts are very plain as to the relation of heredity to animal and human diseases.

AIR.

Air is a very frequent source of disease. Composition in a general way:—oxygen 1-5, nitrogen 4-5; more accurately, oxygen 20.97%, nitrogen 79.% and CO₂, .03%.

Impurities in air are either organic or inorganic. They are taken care of by nature through diffusion, oxidation, sunlight, and plant life activity.

Organic impurities in air are germs of several hundred different kinds; scales and debris of epithelium, hair, sputum, dried manure, dried pus, and various matters from sewer pipes and marshy grounds.

Inorganic impurities are abundant; e. g., bits of various solid particles which may travel great distances.

Relation to disease.—Diseases related to impure air are many and serious; e. g., total mortality among French cavalry horses was formerly as high as 18% to 20%, but reduced by ventilation and better sanitary conditions to 7%. Farcy in the English cavalry used to be exceedingly common, but is now rare. In 1857 there was a serious outbreak of influenza that could not be checked until certain stables were cleaned and ventilated.

Horses' lungs have 289 feet of air absorbing surface or five times the skin area. They may contain at one time 1.5 feet of air. Horses at rest may give off 6.5 to 7.5 cubic feet of CO₂ every hour.

Air begins to get foul and dangerous when oxygen is reduced to 20.6%, or taking another means of estimating, air begins to be foul when CO₂ goes above .05%.

Carbon dioxide is most abundant close to the ground, because heavy. It is not very poisonous in small quantities of itself, but serious because of the poisonous inorganic impurities with which it is associated. It is rapidly fatal when it constitutes more than one per cent. of total air. Its effects on animals, when in excess, are: decrease of arterial pressure, supplants oxygen in blood, causes paralysis of heart, and causes overwork, then failure of the lungs.

Hydrogen sulphide may also be present in the air. Four per cent. is fatal to horses. It causes diarrhoea and extreme weakness.

Nitrogen is nearly negative in effect. It dilutes oxygen and CO_2 .

Ammonia in air must also be regarded as an impurity so far as animal life is concerned, mainly because of the organic matters with which it associates. Such organic matters adhere to ceiling, walls, harness, floors, etc.

Ventilation.—Ventilation, therefore, is very important and should be thorough. Accomplishes two purposes: admits oxygen, dilutes and removes impurities. Good ventilation implies rapid change in air of the stable without direct draughts upon confined animals. Each mature cow or horse should have about 1,500 cubic feet of air and this should be renewed frequently (see lecture on ventilation).

Sunshine is equally important, for sunshine is nature's universal disinfectant, killing more or less rapidly germs of disease

LECTURE XXI.

CAUSES AND PREVENTION OF DISEASES.

FOOD.

Food may be a factor in animal disease when excessive in amount, insufficient, too concentrated, too coarse, bulky and innutritious for the animal that receives it; poor in quality; when given in a poorly balanced ration or at irregular or improper intervals; when given a very tired or hot animal; when carrying vegetable or animal parasites; or when suddenly changed; e. g., poor to rich pasture and when poisonous.

Excessive amount.—Common tendency to overfeed, results in azoturia, heaves, colic, etc., among horses; milk fever, etc., among cows, and favors the development of all febrile diseases. Only a certain amount can be absorbed or used, the remainder causes trouble.

Deficiency predisposes to all diseases that are favored by a lessened vitality. Glanders and similar diseases are especially apt to occur or to increase in severity among horses that are poorly fed. Deficiency in food mineral matters predisposes toward certain diseases of bone. Deficiency of albumin results in loss of energy and strength and animals so fed are apt to be languid and weak.

Coarse, bulky and innutritious food may cause colic, indigestion, heaves and impactions, especially apt to cause trouble with animals with small stomachs; e. g., horse.

Poor quality, e. g., hay cut too ripe or rained on after cut, light oats, etc. Objections same as deficiency, also favors colic, impactions and anaemia.

A food may be *poorly balanced* and dangerous though very nutritious; e. g., beans, wheat, oil meal and cotton seed meal contain alone too much protein and not enough ash, fat and carbohydrates. When fed in the unbalanced ration such excess of protein may cause febrile disturbances, diarrhoea, congestion of the liver, azoturia and milk fever. A similar excess of carbo-

hydrates or fats may cause an injurious deposition of fat under the skin; into and between the fibers of voluntary muscles, or in the heart and liver; e. g., fatty degeneration of the liver. Excess of fats causes diarrhoea and checks absorption.

Faulty intervals interfere with digestion and thrift, may cause such disorders as colic and impaction. Cow may be fed at longer intervals than horse; but both should be fed regularly. A horse that goes a long time without food and then gets abundance is apt to have colic.

Vegetable parasites, like bunt, smut, rust, ergot and mildew may cause abortions, diabetes and anaemia.

Animal parasites infest several foods; lessen their food value and cause skin troubles.

Sudden changes, from poor to rich pastures favor anthrax, hoven, impaction, and black leg.

Class differences.—Some animals may eat with impunity what others cannot. Rich cereals may cause laminitis in horse;—not in cow. Pigs can eat acorns freely, but they are injurious to other animals.

WATER.

Water may be a factor in animal disease when excessive in amount or deficient, when containing low forms of vegetable life, when containing low forms of animal life, when it has received sewage matter, when very hard; e. g., containing much calcium and magnesium salts, when given at improper intervals or soon after eating, or when given in large quantities to a very hot or tired horse.

Excessive amount lessens the digestibility of foods, causes an increased tissue waste and favors indigestion. Horses that have been excessive drinkers are frequently more thrifty, and will keep on less food when given less water.

Deficient water supply may cause impactions in cattle and lessen the excretions from skin and kidneys in horses. Horses need about 2 gallons and cows giving milk about 4 gallons of water per pound of dry food; i. e., horse needs in fall and winter about four to six gallons and in summer about eight to ten gallons per day, the amount varying according to diet and condition of the atmosphere. Cows need much more than horses in proportion to weight and feed, and can be usually trusted to

drink at their own pleasure. Horses will frequently drink too much, especially when tired or hot.

Vegetable parasites frequently contaminate drinking water, and in this way water may serve as a source of transmission for many of the germ diseases, e. g., anthrax, foot and mouth disease, hog cholera, and glanders.

Animal parasites often contaminate the water supply, and in this way serve to spread diseases which they cause, e. g., intestinal parasites, which injure the health of many animals, especially young ones.

Sewage matter may get into drinking water from various sources and cause abortions and poison the system in many ways that may result in different diseases.

Hard water may contain much calcium, magnesium, etc., and cause indigestion, unthrifty conditions, perhaps bony tumors and calculi. Although the latter statement rests on little evidence.

Intervals may be wrong. Horses should be watered regularly and at short intervals as convenient. They should be watered before feeding as a rule and should not be given large quantities of water, sooner than one hour after eating grain. Not so important with cows whether they be watered before or after eating. Much cold water interferes with digestion and when given to a very hot or tired horse may result in founder or indigestion.

LECTURE XXII.

CAUSE AND PREVENTION OF DISEASE.

PARASITISM.

Parasitism may be mutual or selfish, temporary or permanent, external or internal.

Mutual parasitism is one in which both organisms are benefited.

Selfish parasitism is where one party is benefited, the other injured. This is the kind we usually deal with in medicine.

Temporary when only a portion of the parasite's life history is with or upon the host.

Permanent when its whole life history is with the same host.

External or internal; i. e., affecting the body surface or affecting the internal organs.

General classes.—In studying diseases of domestic animals, we deal mainly with two general classes: worms and arthropodes.

Worms.—Invertebrates with soft contractile bodies, either composed of similar rings or non-articulated; excretory organs in pairs opening externally. Members of this group affect many of the internal organs and superficial parts as well.

Arthropodes.—Invertebrates, limbs jointed, bodies composed of dissimilar rings. In this group also we find both external and internal parasites.

Sources and causes of parasitic diseases.—Parasites may be received into the digestive apparatus with food or drink; they may gain entrance through the respiratory tract; through the broken skin, or there may be external infection by contact.

Predisposing causes.—Species of host; age of host; condition of host; season of year and climate. Most animal parasites are enormously prolific, but very many eggs and immature forms are destroyed. Others never reach their proper host. Female louse may become ancestor of 10,000 lice in eight weeks; female itch mite may be ancestor of 1,000,000 in three months, or a certain tape worm will furnish 150,000,000 eggs in one year.

How nourished.—Parasites usually live on the exudate or excretion which results from their presence. Some have mouth and digestive organs; e. g., round worms of the intestines. Others receive their nourishment by surface absorption or osmosis; e. g., tape worms.

Effect on health of host depends on the organ or organs invaded; the rapidity of multiplication; the amount of nutrition used by parasite, and amount of irritation caused.

Intestinal parasites cause trouble by obstruction; by irritating and abstracting blood from the mucous membrane; by mechanical irritation, and by using nutrition. Hence we have symptoms of indigestion, colic and unthrift.

Liver parasites cause jaundice and general anaemia.

Lung and bronchial parasites cause bronchitis or pneumonia.

Parasites in the blood vessels cause disease of the vessel walls, and may indirectly cause obstructions and colic.

Parasites in the brain are more rare and usually fatal.

Parasites in muscular tissue may cause little disturbance to the animal host; but be very serious to human health; e. g., pig measles, trichina, actinomycosis (lumpy-jaw).

General prevention.—Parasitism would be impossible if everything that comes in contact with the animal body were free from parasites. Saddles, harness, blankets, posts and fences are the usual agents which spread Texas itch or mange among horses, and round intestinal worms generally gain entrance in the egg or immature form, with the water drunk. Ponds, wells which receive surface drainage, sluggish streams and marshes, should therefore be regarded with suspicion. Sound animals should not be allowed in sheds, yards or barns where animals diseased by external parasites, like lice or scab mites, have been, until such structures have been disinfected. Dogs are dangerous factors in sheep pastures, because of the tapeworms which they furnish to sheep. Intestinal worms which appear in the manure of horses should be destroyed with boiling water,—not merely crushed and thrown away.

General treatment.—Medical treatment must be such as will destroy or remove the parasites. Medicines may aid us in removing parasites, by suffocating them; e. g., as with oils; by intoxication of the parasites; or by caustic or irritating chemical effect on the bodies of the parasites. Many parasites dis-

appear by means of their own activity and habits; e. g., ticks, bots in horses, grubs in backs of cattle, and grubs in the nasal passages and head cavities of sheep. It is well to remember also that many parasites can resist stronger medicines than the organs or tissues they invade; e. g., bots in the horse's stomach.

EXTERNAL PARASITES.

Most serious are the mite diseases: itch, mange, and sheep scab, lice, ticks and ringworms.

Mite diseases (*acariasis*).—The various forms of itch or mange in horses, cattle, and hogs; scab in sheep; scabies in cats and dogs are all similar in cause, contagiousness, prevention, damage done and in treatment.

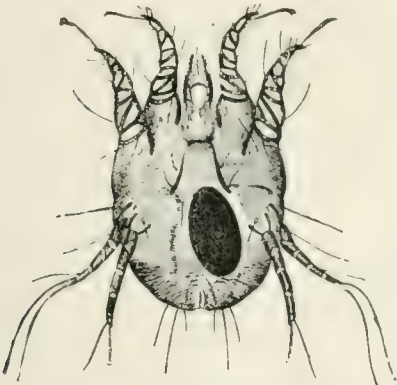


FIG. 33. MANGE MITE.
The cause of one form of horse
mange. *Psoroptes communis equi*.



FIG. 34. CATTLE LOUSE.
FEMALE.
Haematopinus eurysternus.

Causes.—Three types of mites, or acari, affect man and the lower animals, all very small: (a) sarcoptes, (b) psoroptes, (c) symbiotes.

Sarcoptes burrow channels and live in or beneath the cuticle. The eggs are laid and young hatched in these channels. These mites may live 14 days in ordinary stables on harness, blankets, or woodwork.

Psoroptes live on skin surface. They can move around on the surface and spread rapidly.

Symbiotes affect regions near the feet and move about very little.

Diagnosis is made on the condition of the skin, which becomes dry and wrinkled or leathery with hairs partly gone; in-

tense itching and the mites may be found among scales and roots of hairs, by standing the patient in the hot sun on the south side of a building, or by scraping off some of the diseased skin on a piece of black cloth and laying this in the hot sun. The mites may then be seen with a lens.

For the sarcoptes which burrow, it is necessary to scrape deeply. These latter will not live so long in the sun as the others.

General treatment.—For mites the treatment is essentially the same among all animals. Scrubbing brush, with soap and warm water is a great help and then some application to kill the mites. Sheep are dipped, larger animals are usually bathed. Shearing of sheep is almost necessary to satisfactory treatment. Clipping the larger animals is quite an aid. Treatment must be thorough and directions followed. Sheep must go under, head and all. For treating mange in cattle or horses the old fashioned lard and sulphur, freely applied and repeated several times if necessary at intervals of 8 to 10 days is very satisfactory, having given good satisfaction where coal tar preparations have failed. The latter are usually satisfactory, however, if used in sufficient strength.

General prevention of all forms of acariasis is merely the prevention of a skin infection. Generous feeding is a good prevention for many of the parasitic diseases, because it does not allow animals like colts and calves to become thin and weak, and thus easy subjects for parasitic invasion. Tonics are frequently valuable to build up strength and increase the resisting powers.

LECTURE XXIII.

EXTERNAL PARASITES.

Lice (phthiriasis), treatment.—(1) Bathe the affected parts with corrosive sublimate in water 15 grains to the pint; or (2) tobacco water (steep for an hour two ounces of tobacco to each quart of water); or (3) for small surfaces, as mane and root of tail, kerosene one part, linseed oil 10 parts; or (4) Prof. Riley's kerosene emulsion made as follows: kerosene 2 gallons; soft soap $\frac{1}{2}$ lb.; water one gallon. Dissolve the soap in water by boiling and add kerosene slowly while still boiling. Churn ten minutes and dilute by adding 8 times its bulk of water. This is cheap, harmless and satisfactory.



FIG. 35. SHEEP TICK AND ENLARGED PROBOSCIS.
Melophagus ovinus. Properly a sheep louse.

Any treatment for lice should be repeated several times at intervals of one week. It is frequently advisable to whitewash stalls and sheds. All harboring litter should be removed and burned. Clipping is a great aid in the treatment of external parasitism.

It is difficult to treat sheep successfully for either lice or scab without shearing.

For cattle, horses and young stock, in cold weather dust

into the hair along neck, back and rump, Persian insect powder, or use solution No. 4, and blanket if stable is cold. A little kerosene oil on a root, fiber or bristle brush, used frequently, is safe and effective if used with reasonable caution.

For poultry use whitewash in abundance, and plenty of fine air-slaked lime dusted into the nests and on the floor. It is a good plan to throw a handful at a time against the wall so that it will float in the air and then gradually settle down into crevices and over the poultry. Or spray kerosene over the walls and ceiling and wash perches frequently with kerosene. This is cheap, rapidly applied, and very effective. Give constant access to dust bath of dust or sifted ashes, air-slaked lime, sulphur and Persian insect powder. Keep poultry house dry.

Other External Parasites.

Ticks are effectually destroyed by oily preparations; e. g., No. 3 or 4 after shearing.



FIG. 36. HORSE BOT FLY AND LARVA.

Gastrophilus equi. Larva in the third stage.

Ring worm appears most commonly on heads and necks of cattle, especially calves; but man and all domestic animals are also subject. It is caused by a vegetable parasite.

Use scrubbing brush, soap and warm water, then apply every other day 10 per cent. carbolic acid in glycerine, or tincture of iodine and tincture of iron, equal parts.

INTERNAL PARASITES.

The most common internal parasites are round worms, flat worms and bots.

Bots.—Medical treatment has not proven satisfactory.

Nematodes (*round worms*).—For the pin worms in horse, empty the rectum by means of warm water injections and then use warm rectal injections of astringent and bitter medicines, like a very mild solution of copperas or a strong tea made of quassia chips. Repeat once daily for two or three days, and follow with an oily physic; e. g., one quart of raw linseed oil.

For the long white worms the treatment must be vigorous and continued. Use three times daily either (1) or (2) as follows:

(1) Arsenious acid 5 to 10 grains, for ten days, beginning with the smaller dose and increasing gradually to the larger. On the 11th day give linseed oil 1 pint and Croton oil 30 drops. Shake well. The arsenious acid to be well mixed with damp food.

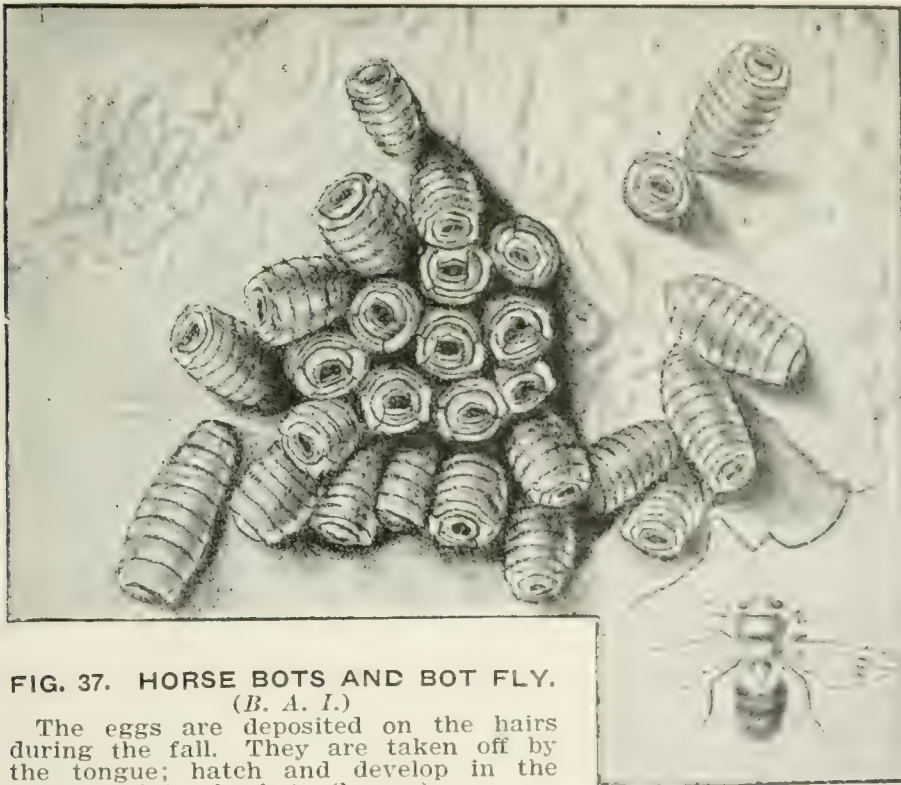


FIG. 37. HORSE BOTS AND BOT FLY.
(B. A. I.)

The eggs are deposited on the hairs during the fall. They are taken off by the tongue; hatch and develop in the stomach, into the bots (larvae).

Or (2) give a cathartic of one quart of linseed oil, feed little or no hay for four days, then give 2 ounces of turpentine in one quart linseed oil on the 5th day and repeat on the 6th. Repeat this whole process beginning on the 16th day, if the first treatment does not seem effective.

For more extended study of internal parasites see "Common Diseases."

Tape Worms, (flat worms).—Most serious in sheep, which are infested by at least eight species.

Treatment can only be useful before weakness begins. For large lambs and yearlings, give no food the night before; then

give each in the morning two drams of ethereal oil of male fern in 2 to 4 ounces castor oil.

Or after fasting, give to each sheep powdered areca-nut 2 drams; oil of male fern 1 dram in 4 ounces of syrup, follow by four to six ounces of castor oil the next day. For older sheep give from a half more to twice these doses.

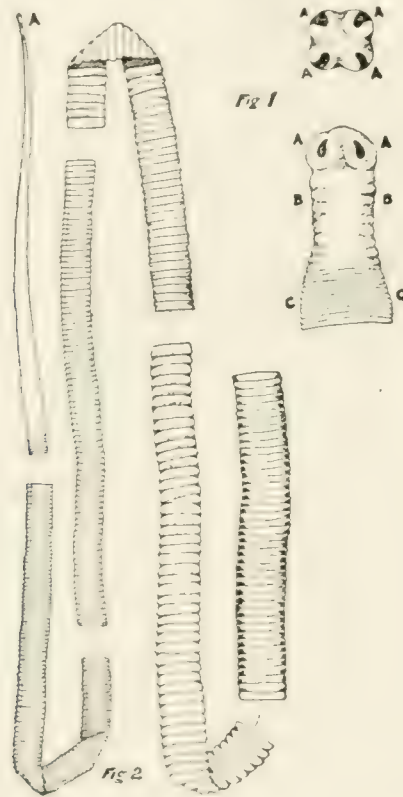


FIG. 38. A COMMON TAPE WORM OF SHEEP. (Curtice.)

Tænia expansa.

1. Head and Neck. A, A, Suckers; B, B, folds in neck; C, C, first segments.
2. Head and Body, Showing Segments. A, Head.

For intestinal worms in swine, santonine 5 grain dose repeated if necessary, or 25 drops turpentine three times a day.

LECTURE XXIV.

STOCK POISONING.

It is probably safe to say that stock poisoning, except by poisonous plants, is very rare. Occasionally cattle are poisoned by taking boiled linseed oil or eating Paris green; horses are sometimes poisoned by boiled linseed oil, given by mistake as a medicine.

BY POISONOUS PLANTS.

General considerations.—Poisoning by plants quite often occurs early in the season, or when stock is put on pasture to which they have not been accustomed, and especially when the animals are hungry at the time of change. The effects seem to depend to a considerable extent upon the amount of food in the stomach and upon the physical condition of the animals. Hungry stock may eat plants which would not ordinarily be taken at all, and the total amount eaten has very much to do with the seriousness of the illness.

Cottonseed meal has an undeservedly bad reputation. It is very probable that the trouble for which it has been blamed, is due to the error of using too large a proportion of this food, which is very rich in nitrogenous elements, and not to any poison which it contains.

Three groups.—Poisonous plants may be divided into three groups. *First*, those causing very sudden death—such as sorghum and wild cherry leaves, which contain prussic acid. *Second*, the irritating poisons, such as the bracken fern, water hemlock, wild parsnip and wild mustard. *Third*, poisons which produce profound disturbance of the nervous system, such as paralysis, interference with the special senses, delirium, disturbed heart action, and insensibility. Among these are included jimson weed, loco weed, poison hemlock, wild parsnip, larkspur and laurel.

SORGHUM.

The information concerning sorghum plant poisoning is comparatively new and there are many points concerning which more information is needed. There seems to be abundant evidence that stock, particularly cattle, may be poisoned to a very serious extent by eating sorghum plants, especially plants that are not of vigorous growth.

Symptoms.—Those who have had a chance to study these cases report that the principal symptoms are stupor, discharge from the eyes, unsteady walk, jerking of the muscles, and poor circulation. The pupils are frequently dilated and the skin lacks sensation.

Treatment.—Animals poisoned by sorghum usually die so suddenly that treatment is out of the question; the poison being prussic acid, one of the most active poisons.

Prevention.—This trouble occurs especially when the stock is first put into the field. The trouble can usually be avoided by first testing the safety of the food by putting in one animal for a few hours, and if no harm is noticed then the entire herd can be turned in and as a rule—with safety.

EQUISETUM (*Equisetum arvense*).

This plant is commonly called jointed rush, pine top, colt's tail, etc. It is a very common weed growing especially on damp, sandy or gravelly soils. It is probable that poisoning from hay containing this plant is much more common than is usually supposed.

Susceptible animals.—Horses are especially susceptible to the poisoning from this plant, and the younger horses are more susceptible than older ones. Cattle do not seem to be poisoned by it.

Symptoms.—The horse is unthrifty, becoming very poor and weak, with imperfect control of the hind legs. The appetite may be good, but the horse refuses to lie down, as a rule, until very late in the history of the case. He struggles a great deal after going down, and finally dies—worn out from the struggling. The pulse is slower than normal until very late in the case. Temperature is normal or below, until the struggling causes both it and the pulse to rise. (Rich.)

Conditions affecting activity of the poison.—Old horses are less susceptible than younger ones. Horses having good grain feed resist longer than those that are insufficiently fed; the trouble seems to be caused almost entirely by the plant when fed with the hay, rarely when eaten in a green state.

Treatment.—Administer a cathartic and remove the cause of trouble by discontinuing the use of the hay containing this plant.

WILD CHERRY LEAVES.

There are several varieties of wild cherries which cause poisoning, particularly choke cherries and black cherries. The poisonous property is probably due entirely to prussic acid. The common black cherry seems to be far more frequently the cause of poisoning than any other species. The leaves that grow on succulent shoots seem to be most actively poisonous. They are less poisonous when wilted, and there seems to be considerable doubt as to whether they are poisonous at all when actually dry.

Symptoms.—These are the ordinary symptoms of prussic acid poisoning and develop very rapidly. There is a very weak pulse, difficult breathing, expression of fright, with prominent eyeballs, rapid breathing and death from paralysis of respiration. There is usually a noticeable peach odor in the breath.

Treatment.—When animals take a fatal amount of the poison, death is sudden and there seems to be little use in attempting treatment.

LECTURE XXV.

POISONOUS PLANTS.

WOOLLY LOCO WEED, (*Astragalus mollissimus*).

This plant belongs to the pea family and is quite well known, especially in the northwestern plains country. "Silvery white, silky leaved perennial, eight to twelve inches high, with an abundance of soft foliage springing out in a cluster from a short central stem close to the ground. The flowers are pea shaped and usually purple." (Chestnut.)

Susceptible animals.—Horses are most seriously injured. Cattle and sheep may be affected to some extent, but the financial loss with them is not serious.

STEMLESS LOCO WEED, (*Aragallus lambertii*).

This plant is quite different from the preceding, growing very erect and with few branches. The leaflets are longer and the seed pod has but one cell instead of two. It grows over about the same territory as the woolly loco. The symptoms of poisoning are apparently identical with those of the woolly loco. This plant has about the same range as the preceding—being found especially in the northwestern and western range countries.

Symptoms.—The effect of this poisoning is quite slow in its appearance, and there develops in the affected animal something of a habit or desire for the weed.

During the *first stage* of loco poisoning the horse seems to be a little out of balance mentally, and the eye sight is impaired. After awhile the horse becomes so fond of this plant, that he seems to prefer it to grasses or other food which he might easily obtain.

The *second stage* is a long period of general atrophy, the animal being thin and weak. The hair is dull, and the expression is one of feebleness. The total period of illness may last from a few months to two years.

Treatment.—The only practical and satisfactory treatment is to remove the animal entirely from the range where he can secure the plant.

RATTLE BOX, (*Crotalaria sagittalis*),

Description.—This is an annual, growing three to eighteen inches high; the plant is hairy; the leaves are oval or lanceolate, with very short stems, simple and undivided; flowers resembling somewhat those of the common pea. The pods are very dark in color or nearly black, and about one inch in length. When dried they are rather hard so that when the seeds have become loosened and the pods are shaken it gives quite the effect of a rattlebox.



FIG. 39. POISONOUS PLANTS. (CHESTNUT.)

Woolly Loco.

Rattlebox.

Stemless Loco.

This plant grows in damp, sandy soils, and over a very large section of country especially along the Missouri River. At some seasons it causes quite serious loss. The poisonous principle has not been demonstrated, but it is apparently held by both the seeds and leaves. The loss occurs most frequently when stock is fed hay containing the dried plant. The trouble does not occur very frequently with animals in pasture.

Symptoms.—Symptoms of poisoning are rather slow in development, death coming only after several weeks of gradual decline. There have been observed sleepiness, loud and difficult breathing, and slow decline.

The proper *treatment* is, the removal of the exciting cause, and tonics.

WATER HEMLOCK, (*Cicuta maculata*).

Called also wild hemlock, snake weed, and spotted parsley.

This is an erect perennial, growing three to six feet high. The stem is hollow, with numerous branches and rather rigid. The flowers are white and the roots are spindle shaped, growing in clusters. This plant is found chiefly on damp soils all the way from the Atlantic coast to the Rocky Mountains.

The poison seems to reside chiefly in an oily fluid which is found mainly in the root, but other portions of the plant also contain the poison to some extent.

The American water hemlock is one of the most poisonous plants in the United States. Quite a considerable number of cases of poisoning, both in animals and human beings, have been traced to this plant. It should not be forgotten that it is the roots which are especially injurious.

OREGON WATER HEMLOCK, (*Cicuta v. vagans*).

This is a smooth growing perennial, with upright or straggling stems. The plant grows from three to six feet high. The leaves are compound, and spring from the ground instead of from the stem. It appears commonly on low, marshy ground in the extreme western and northwestern portions of the United States. The flowers are white, and appear in July and August. The root is fleshy and quite characteristic (see figure 40) and is especially poisonous. A piece of root stalk as large as a walnut is said to be fatal to a mature cow.

Symptoms.—The most evident symptoms are acute abdominal pains, difficulty in walking, with vomiting and convulsions. This poisoning is very apt to be fatal.

LECTURE XXVI.

POISONOUS PLANTS.

POISON HEMLOCK, (*Conium maculatum*).

Description.—This plant came to the United States from Europe or Asia. It is now naturalized and quite common in the eastern and middle states, but not very common in the Mississippi Valley. It is smooth, i. e., not hairy or mealy. The stem is hollow; more or less spotted with purple, and the plant is a biennial, growing two to seven feet high. The leaves resemble those of parsley, and the flowers grow in showy white clusters, appearing in July and August. The leaves have a disagreeable flavor, and the odor, especially from crushed leaves, is also disagreeable.

The poison.—The active poison is a volatile alkaloid known as conine, found in the seeds and leaves. The root is less dangerous in March, April and May, but becomes very poisonous later in the season.

This plant does not usually grow in great numbers in any one pasture or field, but is very actively poisonous, so that it does not require the eating of large quantities to insure fatal results.

Symptoms.—The symptoms are those of gradual and progressive weakening, especially a loss of physical strength. Sight is affected, but the mind is said to remain clear. Death results from pulmonary paralysis. In poisoning from water hemlock there are usually present convulsions which do not appear in the case of poisoning from the true poison hemlock. The symptoms of poisoning in cows are especially the profuse flow of saliva, bloating, lack of appetite, feebleness and weak pulse and severe pain.

BROAD LEAF LAUREL, (*Kalmia latifolia*).

Commonly called laurel, sometimes mountain laurel, poison laurel, sheep laurel, and sometimes poison ivy.

Description.—This is a rather attractive shrub, from four to eight feet high; occasionally growing very much higher, with thick, shiny leaves and rather showy pink flowers. The flowers appear in May or June; the plant prefers the rough hillsides, and mountain slopes of the eastern states. The poisonous principle is in all portions of the plant excepting perhaps the wood. It is said to be very intensely poisonous. Horses are poisoned experimentally, but the main losses reported seem to be from cattle and sheep.



FIG. 40. POISONOUS PLANTS. (CHESTNUT.)
 Poison Hemlock. Water Hemlock. Oregon Water Hemlock.

Symptoms.—A mild, persistent vomiting, with flow of saliva, irregular breathing, impaired sight, dizziness, with difficulty in controlling the limbs. Irregular respiration is especially characteristic. Later there may come on a marked drowsiness, passing into complete unconsciousness and death.

Treatment.—Internal use of a one per cent alkaline solution of permanganate of potash has been suggested by V. K. Chestnut of the Department of Agriculture. (See "General Treatment.")

The broad leaf laurel may be taken as a type of the family, to which it belongs. There are also the narrow leaf laurel and the great laurel, which are reported as occasioning fatal poisoning.

DEATH CAMA OR LOBELIA, (*Zygadenus venenosus*).

In some of the states, especially those of the Northwest, there is a very serious loss of stock through poisoning by the death cama. It has been estimated that in 1900 over 3,000 sheep died from this cause in Montana alone.

Description.—The death cama prefers moist, shallow basins and is found in western mountain pastures and on the plains. This is a smooth plant with a single stem, resembling the onion. It varies in height from six inches to two or three feet. Under ground there is an onion-like bulb. The flowers form a cluster and are yellow or yellowish white. The leaves dry up about mid-summer, and after that are not dangerous. Cases of poisoning late in the season are presumably due to eating the bulb. The poisonous principle apparently resides in the fresh stem and the bulb.

Symptoms.—The symptoms as given by various observers are, staggering gait, continuous swallowing motions, difficult or irregular breathing and general uneasiness. Later there comes a collapse, the animal lying for a long time flat on its side and motionless.

LARKSPURS, (*Delphinium*).

Quite a number of species belonging to this order are common in this country, and several of them are of serious importance as sources of stock poisoning. They are erect herbs, with elongated clusters of rather showy flowers. The latter are usually blue, and have a peculiar projection from which the plant gets its name of *larkspur*.

Symptoms.—The various species of larkspur are similar in their poisonous action. The symptoms resemble those from aconite poisoning. The characteristic alkaloid of the larkspurs is very similar in many respects to the characteristic alkaloid of aconite. The physiological effects are also similar.

Among the noticeable symptoms are: muscular spasms, stiff, irregular, straddling walk and persistent swallowing motions.

Treatment.—The treatment for larkspur poisoning should be the same as for aconite. Belladonna or atropia (the alkaloid of belladonna) has given very satisfactory results. The dose of atropia given with hypodermic syringe is for cattle and horses $\frac{1}{2}$ to 1 grain and for sheep 1-10 to 1-3 grain.

GENERAL TREATMENT.

What is probably the best *general antidote* for plant poisoning was developed by Chestnut and Wilcox of the Department of Agriculture, and is prepared as follows:

There is made up a one per cent solution of permanganate of potash and a one per cent solution of aluminum sulphate or one ounce of each in three quarts water, *fully dissolved*. The permanganate solution must always be made up fresh as needed, for it deteriorates very rapidly. It is important that these medicines should be entirely dissolved, especially the permanganate, otherwise it settles to the bottom of the dish and might be given in the pure state with the last portion administered.

The single dose for sheep is from 5 to 10 grains; for a horse 15 to 20; cattle 30 to 50 grains of each medicine. A single dose in this way should be dissolved in from a pint to a quart of water. In the case of sheep it is convenient to make up larger quantity for the total number to be treated, but if any is left unused it must be thrown away. An ounce of the permanganate is sufficient for from 50 to 100 sheep. When made up in the bulk as above solution, the dose for cattle is about 8 ounces; for horses, 4 ounces; and for sheep, 1 ounce.

LECTURE XXVII.

VENTILATION.

Purposes.—There are two purposes in ventilation, viz.: getting fresh air with its oxygen into a stable, and getting impurities out, and these are equally important.

Impurities.—Disease germs and their products, carbonic dioxide gas, various volatile matters from the lungs, together with the various excretions and the products which result from their chemical decompositions.

Necessity of ventilation.—To illustrate the effect of poor sanitary conditions, particularly lack of ventilation, it is only necessary to call attention to the common experience of moving an animal affected with a chronic type of glanders or tuberculosis from a well lighted and well ventilated stable to one where the conditions are the opposite. Under the latter conditions there is rapid development of a disease which had hitherto been mild. It is a common experience that accidental and surgical wounds do badly in poorly lighted and poorly ventilated stables.

Sick animals especially need free ventilation. This is particularly true in certain diseases, e. g., tetanus and diseases of the lungs.

A warm barn in a cold climate is not objectionable, providing sanitary conditions such as abundant air, sunlight, good food and water are provided. But making a barn warm and tight may very easily establish an ideal place for the propagation of germs and the spread of disease.

Degree of impurity.—When one goes into a close room or stable and does not notice anything of the condition which we call closeness, the carbonic dioxide gas will usually be about .3 per thousand. If the atmosphere seems rather close there is ordinarily somewhere near .4 per thousand. If the atmosphere seems very close and is offensive, then according to Dr. D'Chau-mont, there must be about .9 per thousand. This gas is some-

what objectionable of itself and is especially important as being a reliable guide as to the prevalence of certain organic impurities which are more directly and positively harmful.

Natural forces.—*The factors that operate in natural ventilation are:*

- 1st. The force of the wind.
- 2nd. Weight of air, as varied by its temperature.
- 3rd. Diffusion of gases in obedience to a natural law.

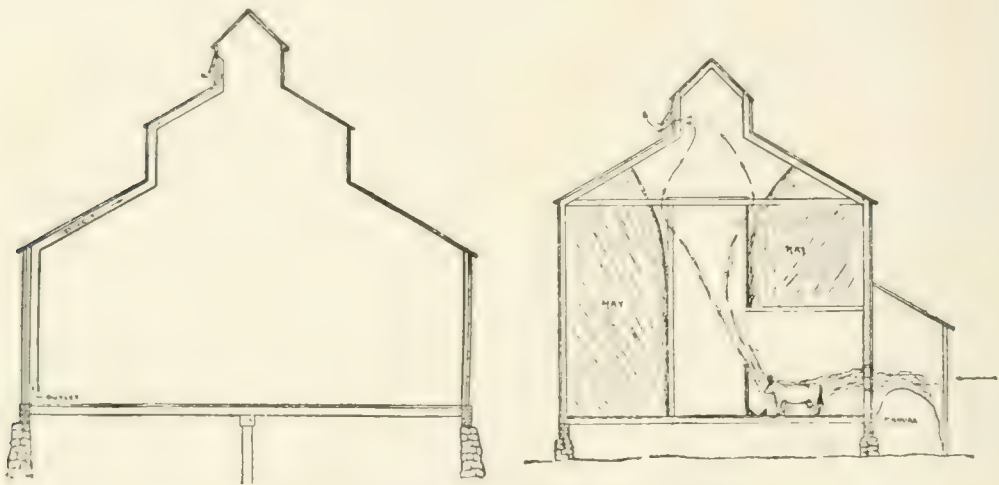


FIG. 41. VENTILATION. (PAIGE.)

Outlet with too many angles.

Cow receiving inlet air from over a manure pile.

Wind.—The force of the wind is probably the most important one of these factors, and must always be taken into consideration in planning ventilation or in mathematical estimates of the amount of air needed. It is of course irregular, but variations can be made in the ventilating facilities to compensate for this. A fundamental point in using this factor is to see that the incoming air does not pass over or through any contaminating source, e. g., over a manure pile, and it is very important that the general plan of construction should be well considered.

Temperature and weight.—The second factor, difference in weight between the lighter warm, and heavier cold air, is not so important in natural as in artificial ventilation, and yet it is a factor of considerable importance. The heat which warms the air in the lower levels is that which comes from the bodies of the confined animals, as it is radiated from the surface, or warmed in passing through the lungs.

Diffusion of gases.—Carbonic gas is considerably heavier than air and the lower levels usually contain a slightly higher percentage than the higher ones in a stable, but the difference is not so great as one would suppose, on account of the diffusion which takes place in response to the law of diffusion of gases—which operates independently of relative weights. This force is so strong in its action that considerable diffusion takes place through unpainted lumber and through ordinary brick, but to a very slight extent if at all through painted surfaces or paper.

AIR CURRENTS.

An entering current of air has the effect of inducing other currents within the stable the induced current setting in at right angles to the inlet current.

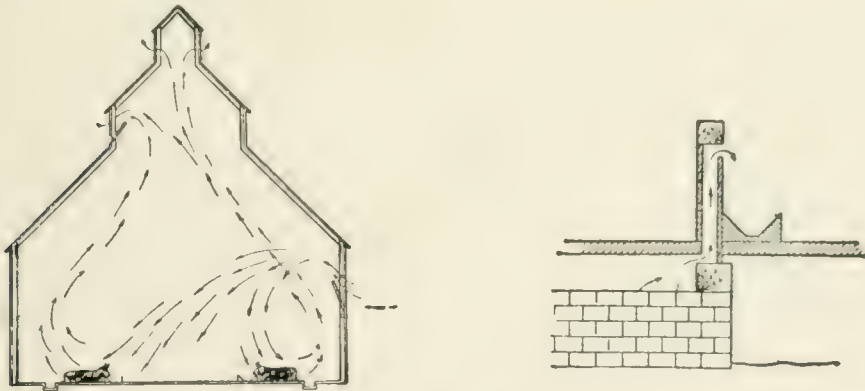


FIG. 42. VENTILATION. (PAIGE.)
Air currents. Manger front inlet.

With windows wide open to windward, openings on the other side of the stable being closed, and with ridge ventilation—it is found that the current of air rushes in, strikes the floor at a variable distance after spreading out somewhat, then rises and most of it passes out at the ridge. A current decreases very rapidly in velocity after the first five or six feet from the inlet. The atmosphere immediately under the inlet is but moderately disturbed.

When opposite windows are fully open the air comes in from the windward side, strikes the ground, rises again and a considerable portion passes directly out at the opposite side.

But a sudden change in the outside currents may temporarily reverse this series.

With the windward window half open, the window on the lee side being open, the current passes directly through the stable without mixing well with the air inside.

If the window on the windward side is half open and the lee window closed, then a strong entering current goes high toward the ceiling, spreads out and diffuses in a very satisfactory way through the stable air and finally escapes through the ridge. If the windows are all closed, and a door open, then the ridge gives a fairly regular outlet ventilation. The exact movement of the air within the stable would be varied, of course, by stall partitions and other obstructions.

A strong wind passing over a stable provided with ventilating shaft may have an outward suction effect especially if some provision is made to insure this result. This may be accomplished by putting a flange around the upper opening so as to direct the outside current of air upward as it strikes the end of the outlet shaft.

Outlets.—In cases where suitable outlets are provided above, and the conditions are favorable, warmed air passes upward and out of the room or building, but if such outlets are not provided then of course the heated air merely rises to the ceiling, cools, spreads out and descends, and no pure air can come in to take its place. If the outlets are too high the effects are practically the same as though there were no outlets at all, for the air becomes cool before it escapes, and falls again.

LECTURE XXVIII.

VENTILATION CONTINUED.

Amount of ventilation needed.—The horse passes 45 cubic feet of air through the lungs per hour. This, then, would be the amount which the average horse would use if he were out in the open where the supply is inexhaustible. It is impossible to have the air of any occupied stable as pure as the outside atmosphere. The purpose of ventilation is to come as near to this point as may be feasible.

It has been estimated that the air should not be changed more than six times per hour in cool weather, on account of drafts which more frequent change would produce, and the loss of animal heat.

Air passing at the rate of three miles per hour, which is barely perceptible, through an opening one foot square, admits 15,840 cubic feet per hour.

STABLE CONSTRUCTION.

Space needed.—A large cubic space per animal is important, but this does not lessen the necessity for ventilation. The atmosphere in a large stable with a given number of animals may become just as foul as a smaller stable with the same number of animals, the only difference being in the length of time required to reach this condition. The chief value in a large amount of space is that it gives the possibility of admitting a sufficient amount of air without such severe drafts, as would necessarily be the result of admitting the same amount of air per hour into a smaller stable.

Location.—In order that a stable may be well lighted and well ventilated it is necessary to have considerable care in selecting the location and planning the proportions of the building. One of the most desirable forms is that of a main part standing east and west and used in a general way for storing

purposes with one or two "ells" at right angles to this on the south. This arrangement makes possible a very satisfactory and well protected yard on the south side, and gives an even lighting to the various portions of the "ells" in which the animals are kept. It will be readily seen that when a stable extends east and west, and is wide enough for two rows of stalls, the animals on the north side do not get much light, for the general lighting of their portion of the stable is poor.

Width.—A stable to be capable of the best ventilation should not be over 25 to 30 feet in width. And the lower the better within limits, when one is depending on natural conditions.

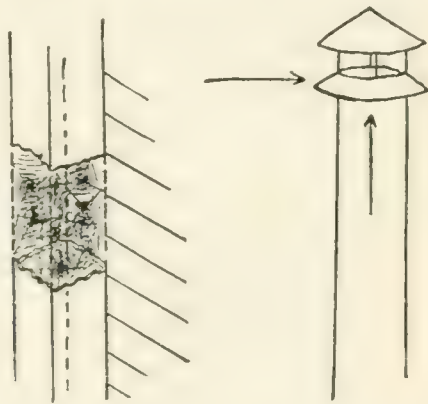


FIG. 43. VENTILATION. (PAIGE.)

Air duct obstructed by cobwebs and dust.

Stationary outlet cowl to utilize the force of the wind for producing upward suction, and to prevent down draft.

Windows.—In order to secure suitable ventilation in a building of this kind two sets of windows should be provided, at least one set on each side. And better two sets on each side. Doors and windows should be opposite, i. e., door opposite door and window opposite window wherever practicable.

It can be stated in a general way that where one is depending upon natural ventilation, and the air is brought in cold, that the inlet should be low and the outlet high; but this does not imply that the stable need be very high.

Shafts and tubes.—In considering ventilation by shafts and tubes, it should be remembered that circular, straight tubes are preferable, and as for outlets, the shorter the better. It is estimated that a right angle bend in an outlet diminishes the velocity of the outgoing air about one-half. Where it is absolutely nec-

essary that an outlet tube should change its course, it should be done in a curve rather than by a right angle bend. All parts of such shafts and tubes should be accessible for cleaning purposes, as it is no uncommon thing for them to become obstructed by cobwebs and dust so as to be practically useless. In a general way the outlet tube if near an outside wall, should be placed on the south side of the building, so as to economize the heat of the sun in rendering it more effective. Central outlet tubes are generally more efficient.

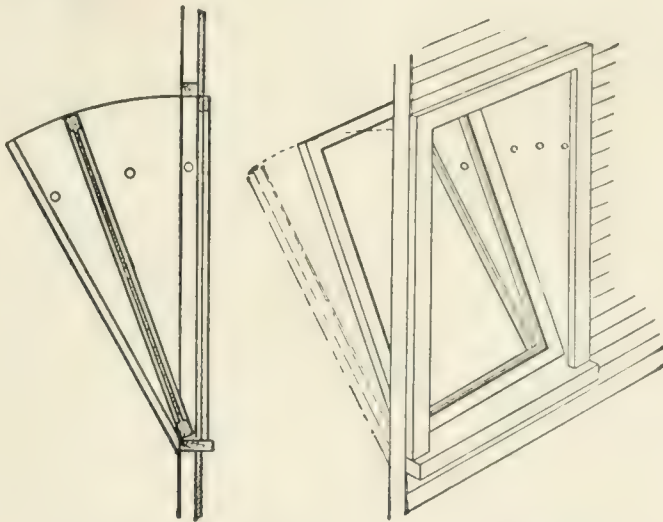


FIG. 44. VENTILATION. (PAIGE.)

Sheringham window in section.

Sheringham window, opening inward. Seen from outside.

Several small inlets are always better than one or two large ones, as they admit the same volume of air, and give it better distribution, without direct currents.

Sheringham valve.—The Sheringham valve is simple and efficient for a stable of suitable construction. This system consists essentially of windows hinged at the bottom and guarded at the sides as to make troughs as the windows open inward. This gives the air an upward current, passing over the backs of the animals and settling down without direct current. There should be two sets of windows on each side, the lower windows being generally used for inlets on the windward side, and the higher windows for the outlets on the leeward side. This affords a very simple, inexpensive and easily manipulated method of ventilation, and may be combined with ventilating shafts. Ventilating shafts should have openings near the ceiling, and also

close to the floor, so that their use can be regulated according to season and temperature. The upper openings of the shaft being used in hot weather, and the lower openings in cold weather.

There should be a number of medium sized or even small windows in this system rather than a few large ones. The same amount of air can be allowed to enter through the small openings without direct draft, and with much better distribution.

LECTURE XXIX.

ACTINOMYCOSIS OR LUMPY JAW.

Definition.— This disease is commonly called either lumpy-jaw or big-head. It is characterized by the development of peculiar enlargements, usually around the head. The disease may also affect internal organs.

The tumors and abscesses which characterize this disease probably have a common origin, being due to the presence and activity of a vegetable organism known as actinomyces. When these abscesses are opened there is usually found in the interior, pus containing minute yellow sulphur-like grains; sometimes very abundant. These yellow grains may be bedded in the diseased soft tissues of the tumors. Seen under a microscope this fungus under certain conditions seems to be composed of radiating club-shaped particles. As the fungus multiplies and spreads the tumor growths increase. The tumors are usually very firm on account of the large amount of connective tissue which they contain. The interior of the tumor is usually somewhat honeycombed with the fungus colonies in the spaces. Animals affected are chiefly cattle, horses and sheep.

Relation to public health.—Human beings are evidently susceptible to inoculation from this disease, but as the affected parts of diseased carcasses are not commonly used as articles of human food, and animal meats as a rule are cooked before being eaten, there is ordinarily comparatively slight danger for human beings. The government meat inspection regulations pass carcasses which are but slightly and locally diseased, and condemn those which are extensively and generally diseased.

Parts involved.—These are commonly the bones of the upper and lower jaws; the soft tissues between the two branches of the lower jaw, and the tongue. These are the external or superficial portions of the body most commonly affected. This disease sometimes affects the lungs and other internal organs and might be

mistaken for tuberculosis. The lung symptoms, as seen on examination postmortem, vary so much that it is rather difficult to describe them. Sometimes the lungs resemble those seen in ordinary broncho-pneumonia. In other cases considerable areas of the lung tissue is changed to a gray mass, soft to the touch. In still other cases there are developed distinct abscesses.



FIG. 45. ACTINOMYCOSIS—LUMPY JAW. (M. H. R.)

Note the enlarged jaw and the raw, granulating tissue exposed.

This disease is usually of slow development. A small swelling appears somewhere about the head, perhaps under the tongue; or the bones of the face near the teeth begin to bulge slightly outward and the enlargements continue very slowly. The animal may remain thrifty for a long time or indeed until the disease involves the teeth, tongue or other organs and interferes directly with nutrition.

Prevention.—There is so little known concerning the life history of the parasite and the methods of infection that a study of prevention can be only partially satisfactory. It is generally agreed that animals develop lumpy-jaw only after inoculation, i. e., the germs find entrance through some cut or scratch in the skin;

through the mucous membrane of the mouth on account of diseased teeth; or through some abrasion of the mucous membrane of the mouth, gullet or stomach. It is also generally agreed that the parasite is usually taken in with the food. It is possible that this parasite may live through one stage of its development, or even multiply upon the surface or in the tissues of some of the common fodder plants, particularly barley and rye.

An animal with a discharging abscess about the head would of course infect food in mangers, feeding troughs and grass in the pasture, thus offering abundant opportunities for infection. Pastures wherein cases of lumpy-jaw seem to develop rather commonly should be placed under cultivation or avoided. Animals with discharging abscesses should be killed or confined.



FIG. 46. ACTINOMYCOSIS. (M. H. R.)
Inferior maxilla of cow shown in Fig. 45.

Treatment.—There are three possible lines of treatment: surgical, caustic, and internal medication.

Surgical treatment.—This should be undertaken, only by a trained veterinarian on account of the large blood vessels and other important structures involved.

Caustic.—Dr. Detmers, formerly of the Ohio Experiment Station, described several years ago a method of local treatment, in which he proposed to remove the tumor by the deeply caustic action of powdered arsenic. He reported a large number of cases treated with satisfactory results. His method was essentially as follows:

The *method* is simple. One-half ounce of powdered arsenious acid is added to two drams of caustic potash, one-half ounce of powdered gum arabic and one ounce of distilled water. This makes a thick syrupy mass. The mixture is kept in a wide-mouthed bottle and labeled "*Poison.*" Take a small stick of hard wood and sharpen it to a point somewhat resembling the dulled blade of a dagger, the tapering end being made as smooth as possible. An incision is made into the abscess pocket, or into the interior of the tumor, as the case may be. Then by means of this piece of wood shove in small masses of absorbent cotton, carrying as much as possible of the arsenic paste. These wads of cotton are placed quite deep in the substance of the tumor.



FIG. 47. ACTINOMYCOSIS. (M. H. R.)
A badly diseased upper jaw.

If the stick is smooth enough it will usually draw out and leave the cotton; if not, the cotton can be shoved off the end by the use of another small stick. From two to six of these pieces of cotton are inserted into the cavity. Within a few days the tumor swells considerably. Later on a large surface seems to become insensitve, the tissues having been destroyed by the arsenic. Finally this dead mass separates and sloughs out.

The *time required* for the complete removal in this way varies from six to ten weeks, but this operation has the advantage of requiring but one treatment. This method is of course applicable in cases where only soft tissues are diseased. The writer has tried this method with satisfactory results, the only objection

and that seemed to be quite a serious one, was that so much time was required for complete removal. It should not be forgotten that, while the slough is separating, the wound may become infected with maggots.

Internal medication.—This treatment is by the internal use of iodide of potash, which is given by the mouth either as a drench or dissolved in the drinking water. Very many cases may be treated with a good prospect of success in this way.

The *dose limit* is about one-fourth dram per one hundred pounds live weight. Each dose is dissolved in from one-half to a pint of water and given as a drench or dissolved in the drinking water. This dose is given once daily until the animal seems to get off feed and discharges freely from the eyes and nose, indicating something of a *catarrhal disturbance* of these mucous membranes. These conditions indicate that the treatment should be discontinued for three or four days. During this period a mild cathartic of epsom salts should be given, about one pound to 1000 pounds live weight. This should be dissolved in water and given as a drench. The iodide treatment may then be continued for another period of six to ten days when it may be necessary to discontinue again and give another dose of epsom salts. Treatment should be continued until the tumor is reduced to about one-third of its original size; it may then be discontinued.

The *time required* for successful treatment in suitable cases varies from four to seven weeks. It is not advisable to undertake the treatment of any case where there is very great bony enlargement, or where there is reason to suppose that there is a very serious disease of the bony structure.

LECTURE XXX.

ANTHRAX.*

History.—One of the oldest diseases known to medical science.

Distribution.—Almost world wide. In the United States, anthrax is sporadic in the North, East, and West; but in the South, more particularly in parts of the Lower Mississippi Valley and along the coast of the Mexican Gulf, it seems to be enzootic.

Animals affected.—All of the domestic farm animals are, more or less, susceptible to anthrax. The disease is transmissible, also, to human beings, chiefly by inoculation, but may be conveyed by means of food or water, or through the inhalation of dried spores, which afterwards develop into the rod-shaped organisms in the blood.

Cause.—A microscopic rod-shaped organism or germ, the *Bacterium anthracis*. The rod stage of the organism is found in living blood, immediately after death, while the spore stage occurs outside of the body. Some authorities claim that this germ may, under certain conditions, lead a saprophytic existence, that is, live upon decaying vegetable matter outside of the body. The rod is more easily destroyed than is the spore. Where conditions are favorable, such as the necessary amount of heat and moisture, the spore may retain its vitality in surface soil, manure, in infected feed-stuffs, blood, hides, hair and wool of anthrax victims for long periods, and be capable of causing fresh outbreaks.

Modes of Transmission.

(1) *By the respiratory tract.*—Dried spores may be inhaled and reach the general circulation by way of the capillaries of the lungs. Human beings following certain occupations, as wool-sorting, mattress-making, etc., obtain infection in this way more often than do the lower animals.

*This lecture contributed by Dr. W. H. Dalrymple of Louisiana.

(2) *By the skin.*—When infection is introduced through the skin, there results the condition known as external anthrax, carbuncular disease, inoculation anthrax, or malignant pustule. This may be occasioned by insects, especially the blood-sucking varieties as the different horse or gad-flies (*Tabanidae*), probably, also, by some varieties of the mosquito; by wounds made by infected instruments or utensils; or other wounds coming in contact with virulent material. In the Lower Mississippi Valley the external form occurs very frequently, and some outbreaks extend over considerable territory, among horses and mules on account of the vast numbers of horse flies during the summer months.

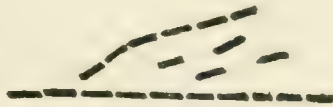


FIG. 48. BACTERIUM (BACILLUS) ANTHRACIS. (M. H. R.)
The specific cause of anthrax.

(3) *By the digestive tract.*—The internal, or intestinal form of anthrax is generally produced through taking the virus in contaminated food or water.

Herbivorous animals contract the disease through grazing over infected pastures, or through cured products raised upon infected fields.

Hogs suffer through eating the flesh of animals that have died of the disease.

Poultry have been observed to die, during epizootics in some of the Gulf States, after eating portions of anthrax flesh and offal; and have, also, been observed to succumb suddenly, and several at a time, after picking off, and eating, horse-flies from the bodies of mules affected with anthrax. The blood in these cases was, however, not examined microscopically.

Methods of introduction and spread.—Imported hides, hair, wool, etc., from foreign countries infected with anthrax. Fertilizing materials manufactured from animals affected with the disease may be a source of infection. Running water may become contaminated, and spread infection along its course. The refuse water from tanneries has been known to disseminate infection from anthrax hides. The wind may sometimes be re-

sponsible for the conveyance of dried anthrax spores. Insects, after feeding upon infected blood and tissues, may transmit the virus to healthy animals through fresh wounds or sores, or by puncturing the skin. Insects may probably, also, infect food materials in troughs and mangers, by conveying virulent matter on their bodies and feet. Carrion birds, through the medium of their excrement, or soiled feet, may infect pastures on which they alight.

Carnivorous and omnivorous animals, as dogs and hogs, running at large, after feeding upon anthrax carcasses, may carry away virulent blood on their feet; and, if these animals die themselves, they become fresh centers of the disease.

Food-stuffs, as pastures, and commercial feeding materials such as the cereal grains and their by-products, hay, etc., raised upon lands infected with anthrax spores, may carry those spores and spread the disease.

Human beings coming in contact with virulent anthrax material, and having their clothes, shoes, hands, etc., soiled thereby, may easily spread the disease.

Neglect to properly dispose of anthrax carcasses is, perhaps, the factor most responsible for the continuance and spread of anthrax.

Period of incubation.—The time that elapses between infection and symptoms, depends upon the method of infection, and amount of infective material introduced, and may range from a very few hours to several days.

Symptoms.

Pulmonary anthrax.—This form is probably not of frequent occurrence in the lower animals. Dried spores may, however, be inhaled from infected hay, whole or crushed grains, etc. There are: suddenness of attack; elevation of temperature, 104 to 108 F.; inappetence; difficult respiration; injection of visible mucous membranes; discharge of blood from respiratory tract; unsteady action of the heart; small and frequent pulse; staggering movements; convulsions, and death resulting from asphyxia. This form is confined chiefly to the herbivora.

External or cutaneous anthrax.—There is swelling at point or points of inoculation (carbuncle or malignant pustule), with

considerable local edema (localized watery swelling). This is painful and hot at first, but afterwards becomes cold and without manifestation of pain. If inoculations have been made by insects, the carbuncles may be numerous over different parts of the body. The swellings extend in the connective tissue along the course of the lymph vessels and nodes.

This form is seen most frequently in the thinner-skinned herbivora—horse, mule, etc.

Internal anthrax.—Sudden seizure, great depression and prostration; rapid elevation of temperature; stupor; muscular weakness and twitchings; vertigo; hurried respirations; increased heart-action, the organ beating tumultuously; visible mucous membranes dark-red, or a bluish-red color; sometimes the coloring matter of the blood passes in the urine. This form usually terminates fatally.

The horse, ass, and mule may exhibit symptoms of internal anthrax without visible external swellings when the virus has been taken into the body with food or water.

In cattle, the internal or acute anthrax is most frequently seen, and without external localized swellings. Tumors are, however, sometimes observed, either as the result of inoculation, or during the course of the acute attack.

In the sheep and goat, there is suddenness of attack; staggering gait; convulsive attacks; discharge of blood from natural openings; and coloring matter of the blood passed in the urine. External anthrax may be produced by contaminated insects infecting wounds on the bodies of shorn sheep, or on their heads, caused by butting. Occasionally there may be found edematous (watery) enlargements on the mammary gland, scrotum, on the throat, and other parts thinly covered with wool.

In the hog, the external manifestations are usually confined to the throat; and there are generally other symptoms of a specific fever present. As a rule, death takes place from asphyxia. The hog becomes infected from eating the tissues of anthrax carcasses; and the disease is most frequent in this animal during epizootics.

Poultry.—There is difference of opinion with regard to the susceptibility of poultry, on account of their normally high temperature, which, it is claimed, is unfavorable to the development

of the anthrax organism. Although microscopic examinations of blood were not made, the writer has known of poultry dying suddenly during severe epizootics in the Lower Mississippi Valley, where access was had to anthrax flesh and other tissues; and also, as previously mentioned, where poultry were seen to pick horse-flies from off the bodies of mules suffering from the disease.

Course of the disease.—In isolated cases, limited outbreaks, and in the early part of an epizootic, the course of the disease is usually very acute and rapid; while, toward the termination of an epizootic, anthrax seems much less fatal, many of the affected animals recovering. Or, in other words, the virulence of the disease seems to become weakened toward the end of an outbreak.

Examination postmortem.—On account of the danger to the operator, and of spreading the disease, through the infectivity of the blood, postmortem examination of an anthrax carcass is dangerous, and is not recommended, except when undertaken by an expert familiar with the possible untoward consequences.

Diagnosis.—This is safest and most reliable by microscopic examination of a small quantity of blood from the extremities (ear of larger animals, or a foot of the smaller), or by inoculation of the small susceptible animals (guinea pig), with anthrax blood, and subsequent microscopic examination of the blood of inoculated cadaver.

Treatment.

Therapeutic.—*Internally*, coal tar products have been recommended. *Externally*, good results have been secured from injecting the carbuncles (swellings) with a 5% watery solution of pure carbolic acid, or the requisite strength of some other effective germicide.

Preventive.—Inoculation by the Pasteur method, practiced annually in anthrax districts, or in sporadic outbreaks, as required. Or, by an alteration of serum and virus. Prevention in this way is very important.

Sanitary.—Cremation of intact carcasses; thorough disinfection of premises (stables, sheds, yards, etc.); drainage and cultivation of infected lands; destruction of horse-flies, mosquitoes, etc.; draining pools and stagnant water where these insects breed or frequent; and by effective live stock sanitary legislation.

LECTURE XXXI.

SYMPTOMATIC ANTHRAX.

This disease is also known as black leg, black quarter, etc.

Definition.—A fatal infectious and enzootic disease of thrifty young cattle. It is apt to appear year after year on certain pastures or along certain valleys. Cattle over two years of age are not usually affected.

Cause.—A short spore-forming bacillus (*Bacillus Chauvoei*). This germ is very resistant, being able to remain virulent for years—under favorable conditions. Infection is usually made by inoculation, either through the skin or mucous membranes, more commonly through the former.

Symptoms.—Local and general.

Local symptoms.—There is usually a pronounced swelling involving either the front or hind quarter. This swelling is characterized by crepitation as one passes the hand over it, due to an accumulation of gas in the loose subcutaneous tissues. The swelling does not extend below the hock or knee. An incision into the swelling reveals the presence of dark, frothy blood, with foul odor. This swelling is not invariable. Some cases, especially those which appear at the beginning of the outbreak and die very suddenly, may not show the characteristic swelling.

Constitutional symptoms.—The constitutional symptoms are usually acute and develop rapidly. The animal is dull, without appetite. It shows high fever and marked debility. The constitutional symptoms may last from one to three days, and the case usually terminates fatally. The fever may reach 106 or even 107. There is lameness in those cases which show local swellings of the front or hind quarters.

Examination postmortem.—This reveals a tumor filled with dark, frothy blood with fetid odor, and more or less filled with gas. The spleen is normal and blood from the general circulation is also apparently normal, clotting readily on exposure to air.

In these features of normal spleen, normally clotting blood and gas filled tumor, this disease differs from true anthrax.

Prevention.—As soon as the disease appears cattle under two years of age should be promptly changed to another and preferably higher pasture. If the young cattle have been on dry food then this should be changed.

Vaccination is now conceded to be very satisfactory and thoroughly practical. There are a number of commercial black leg vaccines on the market, that are quite reliable. The Federal Bureau of Animal Industry is supplying what is known as the government black leg vaccine. This vaccine is quite satisfactory. Method of vaccination depends upon the kind of vaccine used. Directions usually accompany each shipment from any of the reliable makers. The government vaccine is a brownish powder, put in small packets of 10 and 25 doses.

This powder is moistened with a little boiled water, then more boiled water is added; the whole is filtered and the liquid passing through the filter constitutes the vaccine which is injected by a hypodermic syringe. Injection is usually made on the side of the neck or back of the shoulder, through a skin area which has previously been disinfected.

Treatment.—Medical treatment for this disease is not considered satisfactory, or as a rule worth while. Prevention by vaccination is easily applied, inexpensive and usually satisfactory.

LECTURE XXXII.

FOOT AND MOUTH DISEASE.

Definition.—A very contagious disease, chiefly of ruminant animals and swine. Some outbreaks are much more virulent than others, but an outbreak of this disease is always a serious matter for the owner, even though no animals die, and a very serious matter for the public in general. One attack does not give immunity; on the contrary, this disease is apt to recur at comparatively short intervals.

Symptoms.—The symptoms are here given for cattle. Sheep and swine show in general similar symptoms.

This disease develops in from three to five days after exposure. Affected cattle are first noticed to be sluggish. They shiver, and later on they are stiff and lame. There is profuse flow of the *saliva* with frequent swallowing motions and smacking of the lips. The peculiar lesions of the foot and mouth disease are *vesicles* or small blisters affecting the mouth; the skin above and between the hoofs, and over the udder, and teats. These vesicles soon break and bleed, leaving raw surfaces which as a rule heal but sometimes remain as rather chronic ulcers. The skin and superficial tissues around the hoofs become intensely inflamed, and swollen. The *stomach* is also involved; affected animals lose weight; and the milk flow is checked. It should be remembered that the symptoms vary greatly in virulence in different animals and different outbreaks. One patient does not usually show all these symptoms. Affected animals are very much inclined to lie down by reason of the sore feet. This disease is not ordinarily fatal, but causes very serious loss in the checked milk flow, and prolonged unthrifty condition, and seriously diseased feet. There is a marked fever highest just before the eruption appears. Active symptoms of the disease last from eight to fourteen days, and animals usually recover within about three weeks. The disease of the skin around the hoofs often follows the mouth symp-

toms, but the two may occur together. When the disease affects sheep and swine it is apt to involve especially the feet.

Dissemination.—The infecting virus is present in yards, stables, carts, and on the food or feeding utensils. Even a road over which diseased animals may have passed may be infectious. This disease may be disseminated in an indefinite number of ways, and is recognized as one of the most easily scattered of the infectious diseases. The infectious material is apparently present in the discharge from the vesicles, in the saliva, milk, urine, manure, expired air, and perspiration. The infection is probably obtained through the respiratory or digestive organs.

Prevention.—The prevention of this disease is simply the prevention of infection. This country was supposed to be free from this disease until 1902 when it appeared in several of the New England states; and until stockmen are thoroughly sure that the disease has been stamped out, very great care should be exercised in the purchase and shipment of suspected animals. Infected premises that have not been disinfected may remain infectious for an undetermined period. Until we have more positive information on this point we may say that it would hardly be safe to risk exposure in less than a year unless the premises can be thoroughly disinfected.

Treatment.—Simple cleanliness. Most cases will recover without treatment in two or three weeks, but in some serious cases it is necessary to use astringents and antiseptics, for instance, alum water or creolin. This is especially for raw and inflamed surfaces.

LECTURE XXXIII.

GLANDERS.

Definition.—The words “glanders” and “farcy” both refer to the same disease, the latter being commonly used for those forms where the skin and external parts are especially affected. This disease is serious because it may be transmitted to human beings, and with almost invariably fatal results. It is easily spread among susceptible animals. Obscure cases may be highly infectious.

Susceptible animals.—This disease is practically confined to horses, donkeys and mules. Human beings, sheep and goats are susceptible. Cattle are immune.

Causes.—A minute rod-shaped germ (*Bacillus mallei*) which must be recognized as the direct and specific cause of the disease. Unsanitary conditions and everything which lessens the animal vigor may act as predisposing causes. The disease is more severe and more rapidly fatal among animals which are crowded or overworked.

Incubation.—This period varies greatly. Different authors have given it variously from three to seven days in experimental work. In some cases the period of incubation is probably considerably longer, especially in natural cases.

SYMPTOMS.

For our purpose, cases of glanders will be divided into but two classes, viz: glanders and farcy. It is generally customary to distinguish acute and chronic glanders, also acute and chronic farcy, making four types, but acute and chronic cases of each form differ mainly in severity of symptoms and rapidity of development.

Glanders.—This form of the disease is characterized in general by the development of ulcers on the mucous membrane of the respiratory apparatus; by a peculiar discharge from the nose; and

sometimes by chronic cough. Certain glands between the branches of the lower jaw are affected in a peculiar way.

Acute cases.—When the cases are acute, small *tubercles* develop rapidly on this mucous membrane and soon change to small *ulcers* which increase in size and even coalesce. Thus is developed the peculiar ulcer of glanders with its dirty gray base and over-



FIG. 49. GLANDERS—FARCY. (M. H. R.)

A recent case. Note the enlarged leg without farcy buds.

hanging edges. The *discharge* from these ulcers is quite distinctly viscid. Very large ulcers and even ragged gutterlike excavations may develop, particularly on the nasal septum. The ulcers may heal, leaving light colored more or less star shaped scars.

The *fever* may be severe in acute glanders, the temperature rising rapidly to 105 or even 107, and then be quite variable for a few days. There may be also persistent *chills*.

There is apt to be a development of V-shaped areas of lung inflammation in the more acute cases.

Occasionally there is a partial or apparent recovery from the acute symptoms and then

the development of a chronic case.

The *lymphatics* become involved. Certain enlarged glands may be found.

These glands are located well up on the inside of the jaws and more or less adherent. Glanderous disease of these glands may usually be distinguished from other involvements, as for instance, in strangles (distemper) and laryngitis. In glanders they have a peculiar nodular feeling, which is not characteristic of other troubles.

Chronic cases.—If the disease be chronic then these same symptoms in general develop less rapidly. The chronic pulmonary

form of glanders may be suspected when there is a mild, dry cough, especially if such cough be accompanied by debility and occurring in a stable where an obvious case of glanders has been demonstrated. When the lungs are much affected in chronic cases of pulmonary glanders the horse is apt to show symptoms of heaves, and on examination post mortem there are found numerous tubercles, usually showing, or easily felt, on the surface of the lungs.

A horse may be affected with a mild, chronic form of the disease, and remain in good flesh, be vigorous and apparently in the best of health for years, showing no marked nasal discharge or farcy sores, and yet be very actively infectious to other horses.

Chronic cases may also show a chronic nasal discharge, nasal ulcers and nodular, adherent maxillary glands.

Farcy.—In the farcy form of glanders the superficial connective tissues and lymphatics are especially involved.

In the *acute form*, just as with acute glanders, there may be very high

temperature with local swellings. This swelling often occurs in one hind leg, with soreness and lameness. As the swelling abates the characteristic nodules, or so-called farcy buds, appear.

The head may swell badly and later farcy sores appear at irregular intervals and places. These may heal and leave scars—as shown in Figure 51. When farcy buds break there is discharged a viscid pus that is very characteristic of this disease, being clear and quite cohesive.



FIG. 50. GLANDERS—FARCY. (M. H. R.)
An old case. Note enlarged leg with old farcy buds, healed.

The *specific symptoms* of farcy may be summed up as the *bud*, the *ulcer*, the *lymphatic cord* and the characteristic viscid sticky *discharge*.

In the chronic forms we have similar histories and symptoms, but the latter may be less obvious and less rapidly developed.

Diagnosis.—A positive diagnosis on the clinical symptoms may be made in many cases, but there are a great many cases which cannot be so diagnosed with certainty. In these cases we must rely upon the mallein test.

Mallein test.—This test may be conducted as follows: Temperatures are taken at 10 a. m., 2 p. m., 4 p. m. and 6 p. m. The mallein is then given by hypodermic injection at about 10 p. m. On the following day temperatures are taken every two hours, beginning at 6 a. m. and continuing until 6 or even 8 p. m. A rise of two degrees or more above the normal range is diagnostic and is determined by comparing the temperatures taken on the second day with those taken on the first day of test. Such a rise of temperature is spoken of as a reaction. Reacting animals usually show a prominent and painful swelling at the point of injection. Mallein has developed the rather serious fact that there are unquestionably a great many cases of glanders which are never recognized, some of which are without doubt infectious.

Prevention.—The common methods of spread must be borne in mind, and the fact be clearly realized that the germ which causes glanders is very easily disseminated. Some of the more common methods of spreading it are by drinking water, feed boxes and troughs, hitching racks and posts, and in the large cities, by the public water fountains. Any means which serves to bring the virus into direct contact with mucous membranes or with the broken skin may be sufficient to cause an attack. Pus from the farcy sores, and the nasal discharge are very virulent.



FIG. 51. GLANDERS—
FARCY. (M. H. R.)
Farcy scars in the face.
An old case.

Prevention consists in avoiding conditions which may bring the virus into contact with the mucous membranes or broken skin. It is never safe to purchase or trade, from a stranger, a horse that has any nasal discharge or suspicious sores. Stories of having caught cold or having a little distemper may usually be suspected, under such circumstances.

Treatment.—It is probable that some cases of glanders recover under favorable conditions without treatment especially in the Northwest, but this is a very dangerous disease; we have no means of knowing which cases have a reasonable probability of recovery; and medical treatment by the use of drugs has never seemed to give any satisfactory results. For these reasons it is usually conceded by veterinarians that treatment of glanders is not justified. All cases should be reported to the proper health officers.

LECTURE XXXIV.

HAEMORRHAGIC SEPTICAEMIA.

This disease is interesting because of its many forms; it is interesting because medical treatment so far as we know is absolutely useless and hopeless. We are helpless in the matter of prevention because we have practically no information as to the method of infection or method of spread. Those who have had a chance to study outbreaks have been quite unable to trace any connection between one outbreak and another, or to trace a previous history for any given outbreak. This disease is worthy of very serious consideration because it is so wide spread and so fatal. It appears suddenly and under all sorts of conditions; a number of animals, usually a large proportion, die, and the disease disappears as suddenly as it came.

Etiology.—The specific cause of this disease is apparently a germ *Bacillus botisepticus* which has not been distinguished from the bacillus of swine plague by any cultural or morphological characteristics. How this microorganism spreads or how it gains entrance into the animal body is not known, but at present it is supposed that the entrance may be effected by inoculation; through the respiratory; or the alimentary mucous membrane.

History and development.—The onset is usually sudden and unexpected, and yet in some outbreaks the onset is quite slow and the cases are distinctly chronic.

Season and climatic conditions apparently have nothing to do with the prevalence, virulence or disappearance of this disease. The mortality for the past few years during which it has been studied has been high.

Symptoms.—In the writer's experience the temperatures have been uniformly normal or subnormal, except in certain cases where the temperature rose rapidly just before death.

The prominent symptoms in some outbreaks are those which belong to a meningitis, but it would be misleading to suggest that

these nervous disturbances are characteristic of haemorrhagic septicaemia.

Local changes which correspond to the tumors of anthrax and symptomatic anthrax are very limited or wanting.

The urine in many cases has been scanty or blood stained and this is also true of the bowel discharges.

Examination post mortem.—This is very much more definite and satisfactory. The *blood* is apparently normal.



FIG. 52. HAEMORRHAGIC SEPTICAEMIA. (M. H. R.)
Haemorrhages (dark spots) on peritoneal surface of intestine.

Subcutaneous haemorrhages are common and vary greatly in size and intensity; in some cases they are large and the haemorrhagic condition is marked. In other cases the haemorrhages are minute, scattered, and few in number. The haemorrhages may appear almost anywhere in the subcutaneous tissues, or involve any of the internal organs. The *spleen* is not enlarged, but there may be haemorrhages on the surface. The haemorrhages usually have sharply defined borders and are easily recognized as haemorrhages.

The *serous membranes* frequently show small haemorrhagic areas, and the *heart*, especially the auricles are often intensely haemorrhagic.

Summary.—We may summarize the symptoms as follows: In acute cases the disease appears suddenly; the case develops very rapidly and terminates fatally. The antemortem symptoms are very unsatisfactory from a diagnostic standpoint. The post mortem symptoms are definite and as a rule easily recognized and consist of more or less extensive haemorrhages which are sharply defined when they appear upon the surfaces of the viscera and serous membranes.

MENINGEAL TYPE.

History.—Cows which have given a normal flow of milk in the morning may give practically none in the evening. Otherwise they are apparently normal. They may be noticed to be slightly ailing the next morning but showing little aside from dullness. There may be no rise of temperature; no evidence of pain or discomfort. When they attempt to walk, the gait is more or less irregular, resembling very much the gait of milk fever in its early stage. This is of course more marked in some than in others.



FIG. 53. HAEMORRHAGIC SEPTICAEMIA. (M. H. R.)

Haemorrhages on endocardium (internal lining of the heart).

Symptoms.—The symptoms* during the first 24 to 36 hours are not marked except as to continued dullness, staggering gait and cold extremities. The skin is harsh and lacking in sensation. This loss of skin sensation begins at the posterior extremities and gradually extends forward. The milk flow is checked.

After 24 to 36 hours, diarrhea appears, the discharges being dark and thin with very disagreeable odor. Nervous symptoms gradually develop and are quite uniform.

The symptoms during this second period are those which be-

*In case of young calves, the cases may be characterized by profound nervous disturbance very early in their histories.

long to a gradually developing cerebro-spinal meningitis. The inability to walk naturally was continued, the gait being irregular and weak. The neck is often bent to one side and the muscles, particularly of the face and neck, spasmodically contracted. During this period the animals are still quiet, moving around very little; but the eyes show a wild, unnatural expression. During this period the animals may commence to chew in a nervous and very persistent manner, with more or less profuse flow of saliva. The temperatures may remain normal or subnormal.



FIG. 54. HAEMORRHAGIC SEPTICAEMIA. (M. H. R.)
Haemorrhages on costal pleura.

Later, there appears a third fairly distinct period of intense nervous activity. The eyes continue to grow more wild and unnatural; the grinding of the jaws more active and more constant; the convulsions of face and neck muscles become more intense; then gradually a period of intense restlessness and activity, and death ends the scene.

Post mortem symptoms.—Meningitis involving the spinal cord or brain or both is plainly evident. In addition to this there are haemorrhages involving the subcutaneous tissues, and lym-

phatic glands in various portions of the body; also involving the pleurae, pericardium, and surface of various internal organs as in the usual type of the disease.

A peculiar fact which appears in connection with these meningeal type cases is that the animals which are apparently most seriously sick early in their histories are often the cases which live longest, whereas the apparently milder cases die very quickly and very unexpectedly.



FIG. 55. HAEMORRHAGIC SEPTICAEMIA: (M. H. R.)
Meningeal type. Cow stupid. Early stage.

DIFFERENTIAL DIAGNOSIS.

It is very important to distinguish between black leg and haemorrhagic septicaemia, because so far as our present knowledge extends, we are helpless in the presence of haemorrhagic septicaemia. We have no vaccine either preventive or curative, and no medical treatment; whereas black leg can be easily and cheaply prevented by vaccination.

In both diseases, death is liable to occur very suddenly, but black leg commonly affects only cattle under two years of age, whereas haemorrhagic septicaemia affects all ages indiscriminately. High temperatures are characteristic of black leg, especially early

in the history of the cases, whereas, in haemorrhagic septicaemia the temperature is often normal or sub-normal until near death, and then in some cases rising very rapidly. A pronounced swelling of the front or hind quarter is rather characteristic of black leg, although in some cases which die very suddenly there may be no noticeable swelling. These cases usually occur early in the history of the outbreak of black leg, and following them there are other cases which show the characteristic swellings of black leg. Swellings of this kind are not characteristic of haemorrhagic septicaemia, and when present at all are small.

Blood taken from a black leg tumor is dark, frothy and with disagreeable odor, whereas blood taken from a case of haemorrhagic septicaemia, even from the small swellings which sometimes occur, is apparently normal. It reddens on exposure to air and clots readily. It should be noted that this is also true of blood taken from general circulation in the cases of black leg.

A diagnosis between these two diseases may, as a rule, be quite easily made by examination postmortem. Here we have in a case of haemorrhagic septicaemia the characteristic haemorrhages which appear as blood-stained or bruise-like areas under the skin; and sharply defined blood-stained spots on the internal organs or the lining membranes of the chest and abdomen. These haemorrhages are not at all characteristic of black leg. On skinning animals affected with black leg, crepitating, gas-filled tumors of black leg are usually found which are characteristic of that disease. These are not found in haemorrhagic septicaemia.

A Comparative Study of Hæmorrhagic Septicæmia, Anthrax, Symptomatic Anthrax (Black-leg) and Cerebrospinal Meningitis.

	Hæmorrhagic Septicæmia.	Anthrax.	Symptomatic Anthrax (Black-leg.)	Cerebrospinal Meningitis.	Remarks
Aet. organism	<i>Bacillus botricepticus</i> .	<i>Bacillus anthracis</i> .	<i>Bacillus chauvoei</i> .	<i>Diplococcus intercellularis</i> , <i>Diplococcus pneumoniae</i> .	
How spread.....	Unknown.	Any infected object.	Food, water, carcasses, discharges, etc.	Uncertain, probably food stuffs.	
Extent of spread, (single outbreak).	Localized.	Wide spread.	Local.	Local	
Infection	Unknown.	Digestive organs, respiratory organs, and inoculation.	Inoculation.	Probably digestive organs and possibly respiratory organs	
Season favoring...	Indifferent.	Hot, dry summer, following wet spring.	Summer and fall.	No information	
Susceptible animals	Very general.	Very general.*	Young cattle, sheep and goat.	Cattle, horses, sheep, goat and dog.	*Swine, but slightly susceptible.
Mortality, per ct..	80-90	80-100	80-100	80-90	
Symptoms.					
Onset.....	Sudden in acute, slow in chronic.	Sudden.	Sudden.	Usually sudden.	
Local swellings ..	Slight or absent.	Rare in acute cases, *no subcutaneous emphysema.	Usually marked and emphysematous.	Absent.	*May be present in other cases.
Urine	Sometimes blood stained	Frequently blood stained or dark.	Sometimes blood stained or dark.	Normal appearance.	
Feces	Frequently blood stain'd.	Frequently blood stained.	Constipation, intestinal contents bloody.	Normal appearance.	
Autopsy.					
Blood, (general circulation) ..	Normal appearance and coagulation.	Dark or muddy, feeble coagulation, doesn't red'n in air	Normal color and coagulation *	Usually normal appearance and coagulation.	*From tumor, dark frothy and fetid.
Hæmorrhages	Usually present, general, clearly defined *	(General, nearly all organs)	Not general, may occur in heart, lungs and subcutaneous tissues.	Reported, but diagnosis is questioned.	*Vary greatly in size and intensity.
Serous cavities...	Hæmorrhages frequent.	Reddish serum usually present	Serum may be present especially in abdominal.	May contain serum.	
Spleen	Normal, except superficial hæmorrhages.	Enlarged, dark soft.	Normal.	Normal.	
Subcutaneous gas, (soon after death).	Not present.	Not present.*	Present before and after death.	Not present.	*General, decomposition rapid.

LECTURE XXXV.

TEXAS OR TICK FEVER.*

Economic importance.—The seriousness of tick fever as a disease of cattle and the bearing of this disease upon the southern cattle industry was not realized until within a few years. Today we know that it is responsible for the death of more cattle throughout the southern states than any other half dozen diseases. Even at this time its true nature is not generally recognized by the stockmen.

Names.—This disease passes under a variety of names, such as acclimation fever, red water, bloody murrain, distemper, town-cow disease, hollow horn, hollow tail, etc.

Causes.—It has been established that the disease is caused by an animal parasite, a protozoan, which attacks the red corpuscles of the blood. Little or nothing is known of the life history of this parasite outside of the blood of the affected animal. Its multiplication in the blood is very rapid and its effects are very destructive, involving especially the red blood corpuscles. It destroys these very rapidly.

Transmission.—So far as known the only natural means of transmitting the germ of this disease is the southern cattle tick (*Boophilus annulatus*)†. Other species of ticks attack southern cattle, but this is the most common and is the only one responsible for the transmission of the Texas Fever germ.

The ticks do not carry the germs direct from one infected animal to another, but the female ticks develop on infected animals and then transmit the germs to their eggs and the young ticks hatching therefrom carry the germs to susceptible animals, which they may chance to infest.

Susceptibility.—Bovines alone seem susceptible to the disease although the tick, which carries the infection, occasionally infests

*This lecture contributed by Dr. Tait Butler of North Carolina.

†Or *B-Bovis* (Riley).

horses and mules. Calves at birth are as a rule immune; but this immunity is gradually lost until at two years of age nearly all are highly susceptible to the disease. Cattle reared in the southern states on tick-free pastures are as susceptible as those raised in the North.

Period of incubation.—The disease usually develops in from seven to ten days after direct inoculation of a susceptible animal with the blood of one infected, or that has acquired immunity from a previous attack. When infection occurs in the natural way, about the same time usually elapses between exposure to tick infestation and the development of the disease. This period is not always uniform, for in some cases no evidences of the disease can be detected before fifteen to thirty days after inoculation. However, a large percentage of cases develop within ten days after inoculation.

Symptoms.—It is frequently stated that tick fever occurs in acute and chronic forms. The chronic form, however, usually follows the acute and appears months after the acute attack. These relapses or secondary attacks are not uncommon in the late fall and early winter. It is then difficult to distinguish them from ordinary debility from other causes except by the history of a previous attack or by an examination of the blood.

Fever.—In the acute type of the disease an elevation of temperature is usually the first noticeable symptom. A temperature of 107 degrees or 108 degrees F. is not unusual but when it reaches 105 degrees or 106 degrees other symptoms usually become apparent. While there are considerable fluctuations in temperature it generally remains high during five to seven days and may then drop suddenly to normal or below. Many animals die during the extremely high temperature, or, if the temperature falls, it is only as a prelude to deaths. The period of subnormal temperature is a dangerous one and collapse should be fortified against. Otherwise an animal may succumb that might by proper treatment be saved.

Other symptoms.—The patient usually stands apart with the head down and back arched. In severe cases or when death approaches, it may lie or fall down. The pulse usually runs from 80 to 100 and the respirations from fifty to sixty per minute. In most cases during the extremely high temperatures, the urine is highly colored, sometimes becoming of port wine color or almost

black. The red color is merely coloring matter from the red corpuscles which are rapidly destroyed by the germs. At first the bowels are constipated, but later diarrhoea is not uncommon. The mucous membranes are usually pale and sometimes slightly yellow. As death approaches and the symptoms become aggravated the animal usually remains down. Occasional periods of excitement or even convulsions may occur.

History of the case.—The most important factor in determining the diagnosis, next to finding the germs in the blood, is the

history of the animal and the presence of ticks. If the animal has not previously been exposed to tick infestation and has recently changed location, or if tick infestation has in any way been rendered possible, a searching examination should be made to ascertain whether ticks are really on its body.



FIG. 56. TEXAS FEVER TICK.
(PETTIT.)

Female engorged. *Boophilus bovis*
(Riley).

Ticks where found.—The ticks are most likely to be found on the tender parts of the skin, such as between the hind legs, on the escutcheon, on the inside of the elbows, or on the brisket which is most exposed. Since the disease may develop within ten days after ticks attack the animal, and this time is not sufficient for them to become larger than twice the size of a pin head it

will be readily appreciated that to find the ticks is not always an easy matter, especially if they are not numerous. Other diseases producing blood colored urine are extremely rare among cattle in this country.

Conclusion.—The presence of the symptoms described may therefore be considered as diagnostic, and good evidence as to the presence of ticks even though these may not be found.

Post mortem appearances.—Only in animals that die during an acute attack are the changes well marked and of those only the more pronounced will be given. Other changes may be seen but they are often only slight, or absent.

The *subcutaneous tissue* may be slightly yellow and infiltrated with yellow colored serum.

The *muscular tissue* is frequently pale and flabby, especially in chronic cases.

The *spleen*, in cases that succumb during the height of or just after the subsidence of the fever, is much enlarged and dark colored. When held up by one end the contents of the capsule will tend to gravitate to the lower end. When cut into it is black, soft and engorged with blood.

The *liver* is enlarged, congested and usually mottled in color, due to bile-injection. The bile is increased in quantity, dark colored, thick and ropy, sometimes almost semi-solid.

The *kidneys* are usually engorged and dark, and the bladder contains urine varying in color from slightly red to almost black.

Prognosis.—The death rate in calves under six months old is extremely low. In cattle a year old it may range from ten to twenty-five per cent. In those two years old it will probably be from twenty-five to fifty per cent, and in those over two years old from fifty to eighty per cent.

Treatment.—This usually proves unsatisfactory. The results scarcely justify the expense and trouble which it entails, except in very valuable animals. During the first stages, when constipation is present, a purgative consisting of from one to one and one-half pounds of Epsom salts and one dram of calomel may be given. This should be followed by two to three ounces of hypsulphite of soda and from one to four drams of quinine three times a day. When the temperature drops to normal, or below, stimulants should be used freely for a short time and be followed by iron and strychnine until convalescence is established.

When the first case appears in a herd all other animals that have been similarly exposed to tick infestation should be removed from further danger of such exposure, and thoroughly greased. Any cheap oil will do but if it be one third kerosene, it will be more effective. This will not only kill the ticks already on the animal but prevent others attacking it. An outbreak can usually be cut short in this way and the losses reduced very considerably.

Prevention.—Immunity to tick fever in mature animals, so far as we now know, can only be secured through an attack of the disease. Cattle raised on tick infested pastures have been ren-

dered immune by mild attacks of the disease before they became fully susceptible. If it is true that immunity can only be secured through an attack of the disease it follows of necessity that the only preventive is the exclusion or extermination of the tick.

The ticks on any pasture or farm may be easily and quickly exterminated and the farm easily maintained free from ticks. Hence, it is possible, if not yet practicable, to exterminate the ticks over the entire South and maintain the country tick-free.

METHODS BY WHICH TICKS MAY BE EXTERMINATED.

1. Keep all cattle, mules and horses out of the tick infested pasture, lanes, and lots for one season, or at least, after September 1st, and the ticks will be exterminated by the next spring.

2. Divide the pasture by a fence, with a rail or board tight on the ground, and keep all cattle, mules and horses out of one-half this year after September 1st, and out of the other half next year, and the work of exterminating the ticks will have been accomplished.

3. If possible burn the pasture over thoroughly, in the spring. Mix sulphur with the salt given the cattle—one part of sulphur to three of salt. Begin not later than April 15th and grease the legs and under parts of the body of all cattle, once a week, all summer. In greasing look carefully for any ticks that may have escaped the grease or attached themselves to the upper parts of the body. If any are found pick them off and burn. The grease should be one-third kerosene and the other two-thirds any cheap sort available. If a little sulphur and tar be added the effect may be improved.

This third method requires considerable care and thorough, regular work to make it effectual and is only practicable when the number of cattle is not too large.

Concerning the life history. —The methods just given are based on the following facts concerning the life history of the tick: The full-grown female tick drops off the cattle when she becomes engorged with blood. Her heavy body and small, short legs make crawling difficult, so she gets under the dry grass, or "trash" close at hand. In two or three days she begins laying eggs and lays from 1,500 to 2,500 during the next two weeks. In very warm weather, under the most favorable conditions, these

eggs hatch in about three weeks. The period may be prolonged for eight weeks, or indeed, the hatching prevented entirely if the weather is sufficiently cold.

The young ticks when first hatched are very small, being scarcely visible. They crawl up the grass, weeds, or small twigs and there wait for the cattle to come along. If the cow does not come along for three months, he will still be there waiting for her. If no cow, mule, or horse comes along in three or four months these small ticks die from starvation, for they have no other known means of obtaining food for development. If the young tick succeeds in lodging upon the skin of a cow, then in three or four weeks (and in cold weather much longer) they reach their full growth. The females being engorged with blood drop off and begin laying eggs as did their mothers.

Neither old nor young ticks crawl far, hence a fence with a bottom rail or board on the ground will stop them, but wire fences do not always afford protection.

Ticks do not crawl from one animal to another.

Eggs laid during the cold weather of late fall and early winter do not hatch, hence go through the winter as eggs and hatch when warm weather comes in the spring.

All eggs laid before September 1st will probably hatch the same fall and, therefore, the young ticks will be killed by the cold winter weather or starve to death before spring.

Inoculation.—Not only does tick fever kill hundreds of thousands of dollars worth of Southern cattle every year and depreciate the value of all those marketed from one-fourth to one-half cent per pound live weight, but it also offers the greatest existing barrier to the improvement of the quality of Southern cattle by rendering the importation of pure bred animals for breeding purposes extra hazardous and expensive.

For the purpose of conferring immunity on imported pure bred or other cattle, a method of inoculation has been found practicable which reduces the loss from fifty per cent or more to ten per cent or less.

Method.—The process consists in drawing from 1 c. c. to 2 c. c. of blood from the jugular vein of an animal not less than two years old that was infested with ticks the preceding summer, and injecting it immediately under the skin of the animal to be inocu-

lated. This will produce tick fever in from seven to ten days. From this not more than one to three per cent will die if the subjects have been selected with proper care and are judiciously handled.

Important conditions.—The animals should be between nine and fifteen months old.

The inoculating should be done during December, January or February, for tick fever is less severe in cold weather.

All ticks should be kept off the inoculated cattle until they have fully recovered from the inoculation fever.

The inoculated cattle should at first be protected from gross tick infestation by having their legs and under parts of their bodies greased.

The inoculated animal should be infested with the first crop of ticks appearing in the spring, for these are probably less virulent than those hatched in the fall, and therefore, produce a type of disease intermediate in severity between the inoculation fever and that caused by the fall ticks.

If these precautions are taken not more than three to five per cent will die from tick infestation after inoculation.

In the opinion of the writer the best method of introducing pure bred animals for improvement of the native stock is to import calves under four months old and allow them to become immunized by tick infestation as occurs with our native born stock.

LECTURE XXXVI.

TUBERCULOSIS.

Importance of the question is evidenced by the fact that human consumption and bovine consumption are apparently the same disease, and this disease may probably be transmitted from cattle to people. It is unquestionably the most serious question now confronting the medical profession.

Prevalence.—The most widespread and universal disease affecting either humanity or domestic animals. This is shown by reports coming from all parts of America and the civilized world. Probably much more prevalent among cattle than suspected. This disease prevails among all of the domestic animals, excepting possibly sheep. Concerning the susceptibility of these animals there is some discussion. Prevalence is probably greatest in the various classes of animals in the order named: cattle, hogs, horses. Chickens are also quite susceptible.

A careful study of prevalence according to class and condition has shown just what any student of sanitary conditions should expect. The percentage was highest in each comparison among "pure breds," in "city dairies," and "poor condition of stables," and "poor ventilation;" but it was shown that farm conditions, good stables and good ventilation did not prevent infection. The percentage in pure bred herds is much higher among grades or natives. These records must not be taken to indicate that farmers should not improve their stock or that pure bred herds should not be maintained. The evident suggestion is that it is unwise to attempt improving a herd by tuberculosis stock or to found a herd upon such stock.

Cause. —No fact in medicine is better established than that tuberculosis is caused by the bacillus of tuberculosis. We cannot have tuberculosis without these germs, and it is probable that no domestic animals or man can be placed under continued exposure to the germs without ultimately having the disease. Certain pre-

disposing conditions undoubtedly have much to do with the development of this disease; for instance, close confinement, lack of ventilation and sunshine, injudicious inbreeding and inherited susceptibility.

Modes of entrance. —(1) Lungs, with inhaled air; (2) stomach and intestines, with food and drink; (3) by inoculation through broken skin or mucous membrane; (4) by infection *in utero*, i. e., before birth. This (4) is very rare and probably of small importance compared with the others.



FIG. 57. BOVINE TUBERCULOSIS. (M. H. R.)
A case showing plain symptoms of disease. Rare type.

Structures affected. —Tuberculosis may affect any tissue or organ of the body. Milk from tuberculous cows may be tuberculous, but the danger is especially great when the udders are affected.

Extent of tissue diseased may vary from a few small lymphatic glands to a general invasion of lungs, liver, kidneys, mesenteric glands, peritoneum and pleura.

Symptoms. —These vary according to extent and location of the disease. A few cases become thin and rough in appearance, and have chronic cough or chronic diarrhoea and show that they

are in a debilitated condition. The great majority of these cases show no symptoms but on the contrary appear to be in the finest physical condition. There are a great many mild or latent cases, having but a small amount of tissue diseased, and the animals may live for many years. They may possibly die at old age, but on the other hand they may succumb to a sudden development of the disease following any condition which produces debility.



FIG. 53. BOVINE TUBERCULOSIS. (M. H. R.)

A famous show steer, in prime "condition." Liable to be as badly diseased as the preceding.

When the *lungs* are involved, there may be a persistent cough, shortness of breath, pallor of visible mucous membranes, loss of flesh and unusual sounds in the lungs.

When *intestines* and mesenteric glands are affected, there may be chronic diarrhoea with slow and persistent loss of condition. All these diagnostic symptoms may vary greatly and are often unreliable; e. g., a cow may be in good flesh, hair and eyes bright, and yet ready to die in a short time.

Diagnosis.—The only reliable test is tuberculin, or Koch's lymph, which seems to be very accurate. An average of tests and post-mortems of reported cases shows an accuracy of over 90 per cent. Tuberculin is used by injecting a definite quantity un-

der the skin with a hypodermic syringe. Temperature is taken before and after the injection. A pronounced rise of temperature (2 degrees F., or more) ordinarily shows the presence of tuberculosis.

Treatment is not practical. It is usually advisable to destroy or isolate diseased animals at once.

Prevention.—Stockmen should breed with a view to increasing physical vigor instead of breeding fit subjects for tuberculosis, as many are doing. Bear in mind that an animal may give a fine physical appearance, and yet be easily susceptible to disease or be actually diseased.

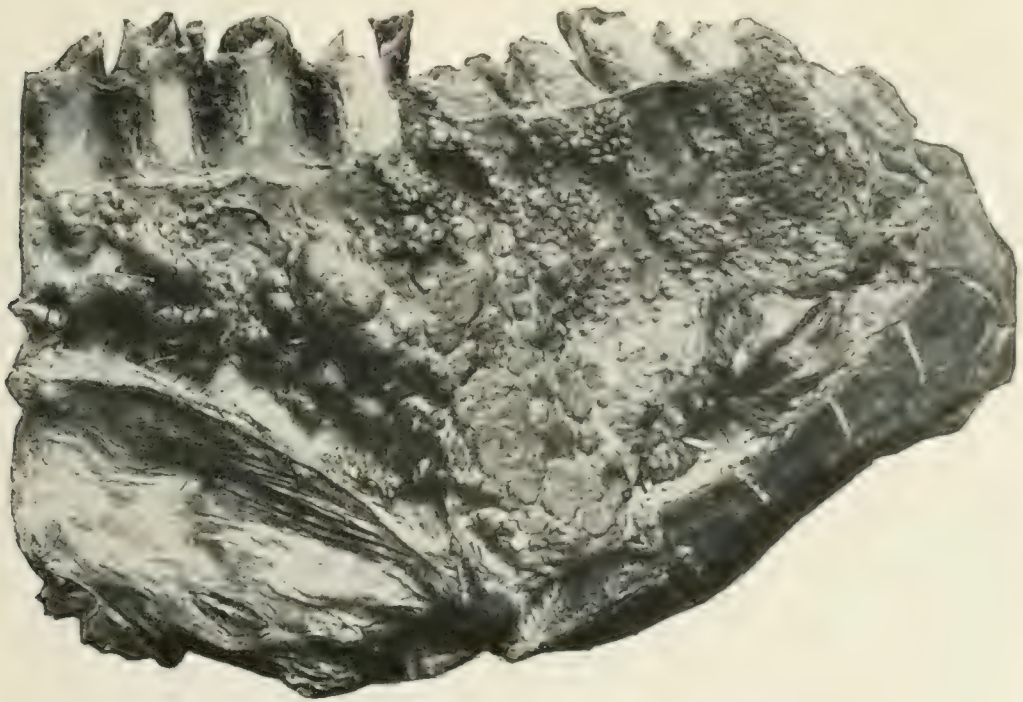


FIG. 59. BOVINE TUBERCULOSIS. (M. H. R.)

A great variety of tubercles on the chest lining (costal pleura). Sternum below, broken ribs above.

The practice of keeping cattle almost continuously in the stable does not harmonize with plain teachings of physiology, and the results of this practice must sooner or later be disastrous. The great law of animal life, that use begets strength and idleness begets disease, applies to lungs, as well as to muscles, and must always hold true. Animals cannot remain permanently healthy without a reasonable amount of exercise, sunshine and fresh air. If lungs are used less than nature intended, they must

necessarily lose in tissue nutrition and vitality, and gradually become absorbed or diseased. It is reasonable to expect such lungs to become tuberculous, for cattle and people alike have frequent opportunities for infection. We must realize that nature's laws cannot be violated without paying an inevitable penalty.

It is unwise to buy cattle for breeding purposes without knowing that they are free from tuberculosis before placing with the herd. All sires, and it is especially true of cattle, should have abundant exercise in open yards or on tread mills, or be driven or worked. Ventilation must be thorough and barns should be constructed with a view to allowing the entrance of unlimited sunshine. Sunshine may spoil the luster of hair, but it also kills germs.

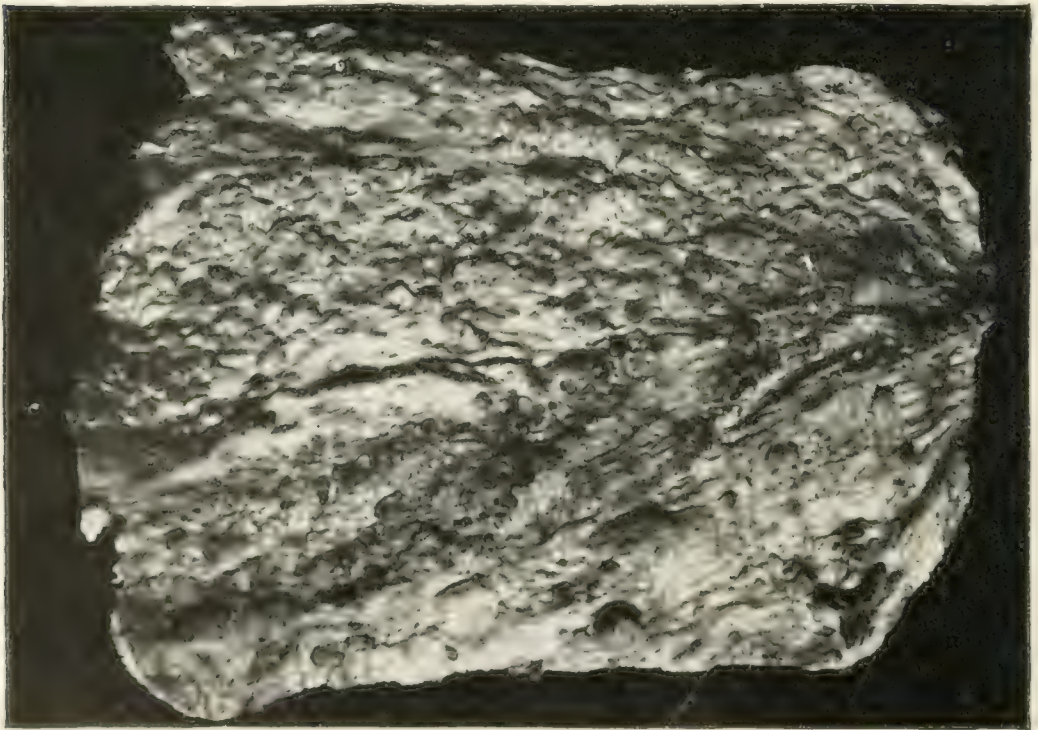


FIG. 60. BOVINE TUBERCULOSIS. (M. H. R.)
Tubercles on the great mesentery.

Summary. —Do not found a herd with tuberculous stock. Do not introduce the disease while trying to improve a herd. Do not allow suspicious animals to stand in stable with healthy ones. Avoid incautious breeding, and close confinement. Ventilate freely. Allow plenty of fresh air, exercise and sunshine especially to breeding stock.

Disposition of tuberculous cattle. — Abundant experiments have demonstrated that sound calves can be raised under favorable conditions from tuberculous cows. It is sometimes practical to free a herd from tuberculosis by breeding out the disease, instead of by immediately killing all diseased animals. It may be wise in most cases to slaughter tuberculous bulls and other tuberculous members of the herd which the owner does not think it advisable to keep in partial quarantine at a somewhat increased expenditure of time and money. It is generally recognized that tuberculous animals should be slaughtered under inspection and certain carcasses passed as fit for food purposes. It may be advisable to feed such animals for a few months before slaughter.

The tuberculous cows retained for breeding must be kept in a separate stable or in a tightly partitioned off portion of the common stable. They must not be watered at the same tank nor fed from common mangers or vessels. The danger in allowing tuberculous and non-tuberculous cattle to associate in the open air is slight, probably. The tuberculous cows may be used for breeding purposes, and one or more crops of calves secured before the cows are finally disposed of. The calves must be raised upon the milk of healthy cows, or boiled milk from tuberculous cows. From 80 to 90 per cent of such calves may be raised free from tuberculosis.

LECTURE XXXVII.

THE TUBERCULIN TEST FOR TUBERCULOSIS.

Tuberculin is usually seen in fluid form and is then a thin, watery, straw-colored fluid, slightly more viscid than water, due to the presence of glycerine used in making up the solution.

Tuberculin is a chemical product from the bodies of the bacilli of tuberculosis, and is made as follows: a certain kind of broth is infected with the bacilli of tuberculosis. The bacilli are then allowed to multiply and grow in this medium until it has become charged with this germ product, tuberculin. The whole fluid is then passed through a porcelain filter and heated to kill any germs that may possibly have passed through a defective filter. It is therefore not only germ-free, but has also been raised to a high temperature and cannot be infectious.

Effect on cattle. —Careful experiments have demonstrated that tuberculin has no important effect, favorable or otherwise, upon the health or milk flow of sound cattle; and that the effect on tuberculous cattle is favorable rather than otherwise. An experiment was conducted at the Minnesota Experiment Station a few years ago, which included 23 sound and 5 tuberculous cows, and compared the total milk flow and total butter fat of the herd for the week prior to test with the week of test. In this experiment the cattle were given ordinary handling, neither very rough nor unusually gentle.

There was a moderate decrease in the milk flow during the two days of test, not more than could be easily accounted for by unusual handling of the cattle and the presence of strangers. This decrease was almost made up during the succeeding five days. There was a slight increase of butter fat during the week of test. Both variations were easily within the limits of normal variation.

The experiment with the five tuberculous cows gave about the same results, the difference being easily within the limits of normal variations, neither the total milk flow nor total butter fat

being materially affected by the test. Similar experiments have been made elsewhere, the results agreeing very closely with this general statement. It is undoubtedly possible for cattle to be so roughly handled during test that the milk flow might be seriously affected, but this cannot be charged to the tuberculin. In cases where serious results accompany or follow tuberculin tests, the disturbance can usually be traced to some cause other than tuberculin.

Accuracy.—Averages of very large numbers of animals tested show that tuberculin has had an average accuracy in diagnosis of over 90 per cent, and in the hands of many veterinarians who have been very careful in their work, it has been almost infallible. Very advanced cases sometimes, although rarely, fail to react. Such cases are easily detected by ordinary symptoms, as a rule.

The test.—Any number up to 60 or 70 may be included in one test. Larger numbers can only be handled to advantage by one who is thoroughly familiar with the test and who can use a number of thermometers.

The injection is made on the neck just in front of the shoulder or else just back of and a little above the elbow.

At least two assistants are needed: one to hold a lantern and assist in managing the cattle, another to hold some sort of a tray, usually a short piece of board, for carrying the needed materials. There will be needed an ordinary tumbler with a good layer of cotton or oakum on the bottom and filled with 4 per cent carbolic solution; a one dram graduate, measured also for c. c.'s; a veterinary hypodermic syringe, holding 3 to 5 c. c., and provided with several short and reasonably strong needles. The syringe rinsed out with the carbolic solution occasionally.

is carried in the carbolic solution, except when in use, and may be

If the operator is without sufficient help, a bicycle lantern can be held in one hand while making the injection with the other. By raising the skin with the thumb and first two fingers, a sort of pocket can be made into which the needle can be thrust with considerable force without penetrating deeply into the muscle. The needle should be inserted by a quick stab, entering at right angles to the skin surface. It is usually advisable for the operator to stand well forward by the cow's shoulder. Some cattle are

inclined to kick just as the operator steps out of the stall. This can be prevented by an assistant giving the tail a vigorous pull sidewise.

Two periods.—The time of each test is divided into two periods: (A) the day before, and (B) the day after injection. During (A) the temperatures are taken at 8 and 10 a. m., then at 2, 6 and 8 p. m. The tuberculin is then given by hypodermic injection at 9 p. m. During (B) the temperatures are taken at 6, 8, 10 and 12 a. m., and 2, 4, 6, and 8, and sometimes 10 p. m.

The thermometer.—Self registering thermometers, commonly known as fever or clinical thermometers, are necessary for this work, and they should all be correct between 100 and 105 F. All thermometers used should first be tested on the same animal and the records compared. Any thermometer which varies one degree or more from the records shown by the others should be discarded.

Temperatures are taken by inserting the thermometer into the rectum or vagina, usually the former. The following simple device has been found very satisfactory. A rubber band is fitted with a wire hook at one end and ring at the other. The middle of the band is then connected with the top of the thermometer by a stout string about 5 inches long. The thermometer is inserted and the band hooked around the base of tail. This permits the operator to use a large number of thermometers and prevents them from falling to the floor and breaking.

Dose.—The dose is about 1 c. c. or $\frac{1}{4}$ dram Bureau tuberculin per 500 pounds live weight. The doses may be measured directly from the bottle, or one or two bottles at a time can be emptied into a small vessel from which the doses can be more conveniently poured into the small graduate. It is very convenient to use a syringe with graduated piston rod or barrel and measure the doses in the syringe.

Cautions.—The cattle must be kept under the same conditions as nearly as possible on both days; i. e., watered at the same hours and fed at the same hours on each day, given as nearly as possible the same amounts and treated alike on the two days in every respect.

There are several possibilities of error if operator is not care-

ful, accurate and observing. The cattle must not be excited or worried in any way but kept as quiet as possible during the whole test. If the whole stable or any portion of it be much warmer on the second day, than on the first, note should be made of the fact and it should be considered in making the diagnosis in doubtful cases.

Cattle that show high temperatures during period (A) should ordinarily be released from test, except in case of heavily pregnant cows. These may be tested, if carefully handled—up to within two weeks of calving. It is always possible that an animal may show normal temperature during (A) and then be feverish from causes not connected with the test during (B). This rarely occurs but the possibility must be borne in mind.

On the other hand a large quantity of very cold water may reduce the temperature one or even two degrees at a critical time in a low reaction.

Importance to breeders.—The value of the test to breeders lies in the fact that it enables them to know whether their cattle are free from tuberculosis, and it enables them to free their herds and put them on a sound and healthy basis in case they are diseased.

Diagnosis is made mainly upon the fever reaction: i. e., if the temperature rises between 8 and 20 hours after the injection 2 degrees or more above the normal range, as shown by comparison of the (A) and (B) temperatures and careless errors have been avoided, it is safe to diagnose tuberculosis. A rise of 1.5 to 2 degrees may be called suspicious and the animal held for future retest.

The reaction.—A typical reaction is one wherein there is gradual rise and gradual decline. Very abrupt changes should be verified with a different thermometer. When the first (B) temperature is not taken until eight or ten hours after injection, there may be a gradual rise and a maximum reached before this first (B) temperature is taken. One or two high temperatures during (B) with the others normal or nearly so, should not be considered as more than doubtful or suspicious.

Animals that react sometimes show diarrhea and a local swelling at the site of injection.

LECTURE XXXVIII.

AZOTURIA.

Prevalence.—Azoturia is a common and very serious disease which affects horses under certain well defined conditions. It is frequently fatal and always affects the best and most valuable horses and is so very easily prevented that it would seem as though the farmer should be familiar with this disease, and his knowledge should come along other lines than that of sad experience. Farm horses in the Northwest do comparatively little work during the winter, and are in high flesh when early spring work opens. This condition, together with the fact that the early spring is necessarily a season of irregular work, will explain why so many cases of azoturia occur during the spring months.

History.—Azoturia rarely appears among horses at pasture or among those doing regular work; but almost invariably *during exercise after a period of idleness on full feed which has succeeded a previous period of work.*

This disease is frequently confounded with colic; sometimes farmers call it spinal disease, and sometimes it is thought to be an inflammation of the kidneys; but is easily distinguished from any of these by the history, which is very uniform; by the symptoms which appear, and by the condition of the urine.

Parts affected.—This is not a disease of the kidneys as one would naturally think from the color and condition of the urine, but primarily a disease of the muscles, then of the blood and nervous system. The blood is dark and tarry, has a varnish like gloss and does not coagulate after death. The liver and spleen are engorged and may be more or less disorganized after death.

Duration.—Mild cases may recover in three or four days. The more severe cases either die in a few days or there may remain a persistent and more or less complete paralysis of the hind quarters and limbs for several weeks.

Causes.—Predisposing and precipitating.

The *predisposing causes* are the factors which favor the development of the disease and include the following: high flesh, diet rich in proteid, and full feed during a period of rest, following a period of regular work. Most cases appear during the prime of life. Mares are more frequently affected than geldings, but all are liable.

The chief precipitating factor is *active exercise, following idleness on full feed* under conditions above given. It is probable that there occurs an accumulation of surplus proteid matters in the system during the period of idleness, which are rapidly disorganized when exercise begins. Just how this excess of proteid matters in the body serves to develop the disease, and what the close connection between this condition and the symptoms which appear, are matters of interesting scientific speculation but need not be discussed here. What part may be played in this disease by sudden exposures to cold after confinement in warm, damp stables is a point of dispute. Some very good and recent authorities ascribe a very prominent place to this condition among the causes of azoturia. It is quite possible that the two conditions of accumulated proteids and sudden exposure to cold may be associated in many cases.

Symptoms.— The symptoms appear suddenly with little or no warning and are very uniform. The horse frequently comes out of the stable feeling unusually well, then after going a short distance there is a sudden lameness or stiffness in his hind legs. Sometimes both are affected alike but usually one first. The horse staggers, is very weak on his hind legs and may fall before he can be unhitched. These patients perspire very freely before and after going down; the muscles over the loins and hips are rigid to the touch, and frequently tender on pressure and may tremble or twitch.

The *urine* is highly colored, varying from red to almost black and is usually increased in specific gravity; *i. e.*, heavier than natural. This abnormal color is due to the presence of the red coloring matter of the blood and voluntary muscles (lean meat), and may be absent in mild cases.

The pulse may run up to 60 or 80 per minute (normal 42 to 48); the temperature may be increased to 102 or 104 (normal 101.5), but in many cases the pulse and temperature vary but lit-

tle from the normal. The bowels may be normal and the appetite fairly good in mild cases. The skin sensation may be diminished as shown by pricking with a pin. The natural peristaltic action of the intestines may be suppressed, but the bowels will usually vacuate under the influence of an injection or other local irritation. A chronic paralysis affecting one or both hind limbs may be a very troublesome factor in the case.

Prevention.—Prevention is simple, easily applied and without expense, and this is the point that should be considered by the farmers, rather than treatment, which is frequently unsatisfactory even when the patient recovers; moreover, one attack predisposes to others. A horse that has had azoturia once is very apt to have it again, and the second attack is more easily brought on than the first. Preventing the first attack may be the prevention of several attacks and of the final death of the horse.

There is but slight danger of azoturia for the horse that is thin and weak, for the young colt or for the aged horse, for this disease usually affects the best horse in the barn, one in good flesh and in the prime of life. When such a horse has been working on full feed for a time and must then stand idle for a few days or even twenty-four hours, *make a very large reduction in the grain ration* or stop all the grain if the horse is quite fat, for a fat horse needs but little grain when standing idle under any conditions, and especially is this true if he has recently been at work. Allow plenty of water and turn out in the yard every day if possible. It would be still better if the horse could be continued at light work. When such a horse has been standing for some time after previous exercise, and the grain has not been reduced as it should have been, the next best thing is to give a decided cathartic, e. g. a quart of raw linseed oil thirty-six hours before hitching, and then work very moderately the first day, for quick or violent exercise seems more liable to bring on an attack than slow and gentle use. This should be borne in mind when taking any horse out for the first time after a period of idleness.

Treatment.—These are difficult cases to treat and *this part of the work should be done by competent veterinarians* whenever such are accessible. The treatment of azoturia is frequently unsatisfactory, even with the most skillful practitioners in charge. The principle purpose of this lesson is to direct the attention to

prevention and not toward treatment, but cases will arise through the hired man's anxiety to have his horses look well when the owner is in no wise to blame, and these cases will occur, too, in parts of the state where competent veterinarians are not located.

If not voided naturally, means should be taken to draw the *urine* as soon as possible after the disease appears, and three times daily thereafter, if there is any one at hand who can do this. This is an important feature in the treatment of severe cases. The azoturia patient has a much better chance for recovery if he can be kept upon his feet a portion of the time at least, and it is very desirable that this be done for several reasons; but slings should not be used unless the patient can support a portion of the weight upon the limbs. When the patient is unable to do this put him in a clean, dry stall with plenty of bedding and turn him three times daily until he can stand with the aid of a sling.

The central purpose in treatment is to stimulate the excretory organs and thus secure rapid elimination of the abnormal and injurious matters in the blood. Cases that show difficulty in breathing with full pulse should be bled from two to five quarts, depending on the condition of the pulse while blood is being removed, then give one quart of raw linseed oil, or better, give one ounce of aloes with two drams ginger made into a pill with a little molasses; encourage the horse to drink as much as possible, and, if he will not drink freely, he should be drenched often with water or be given weak salt brine to make him thirsty. The more he drinks within reasonable limits the better. If restless and violent, the patient should have a sedative; e. g., one ounce bromide of potassium with three drams fluid extract of gelsemium, given in half a pint of syrup. The muscles of the hips and loins should be fomented with hot water twice daily, two hours each time during the first three days of the illness, and after this a stimulating liniment should be used over these muscles twice daily until the patient has recovered.

One or two hours after the physic and sedative dose two tablespoonfuls of the following prescription may be given in half a pint of cold water or syrup, every two hours, till all is given:

F. e. colchicum sem.....	1 oz.
F. e. pilocarpus.....	3 "
Spirits aeth. nit.....	6 "

The purpose of this prescription is to stimulate and assist the kidneys and skin to excrete rapidly. When chronic paralysis remains after the acute stage has passed, nux vomica should be given. Give one to two drams fluid extract nux vomica or one to three grains strychnine sulphate twice daily in feed, beginning with small doses and gradually increasing until there appear symptoms of nervousness and muscular twitching, when the dose should be discontinued or rapidly reduced.

Prognosis.—*Estimates of results* must be given with great caution, for sudden and unexpected changes may occur. Perhaps 40 to 60 per cent die in general practice. Prognosis is bad, when complete paralysis occurs; when the disease develops violently from the start, the horse going down at the beginning and soon loses control of the hind limbs or when the patient grows more and more restless during progress of the disease, or is unable to stand or support part of the weight in the sling. If patient can stand alone or can stand fairly well when assisted by sling, the prospects are favorable.

LECTURE XXXIX.

LYMPHANGITIS AND HEAVES.

Definition.—Lymphangitis is an inflammation of various lymphatic tissues. It appears suddenly and is quite painful.

Cause and history.— This disease usually appears among horses of sluggish temperament, at least these are most susceptible. It almost invariably occurs among horses that are well fed, and after a period of idleness.

Symptoms.— This disease usually makes its appearance with a chill, followed by fever. The horse is uneasy. A sudden swelling appears on the upper portion of the hind limb, on the inside, gradually increasing and extending around the limb and then downward never passing below the hock. The horse is lame, and the affected limb is very sensitive to the touch. The horse perspires freely; pulse, respiration and temperature are all increased. The bowels are constipated and the urine is scanty.

The disease develops for about two days, then maintains its severity for a similar period. This is followed by an abatement of symptoms. Most of the swelling subsides. There usually remains some slight thickening, and the disease is apt to recur, each time leaving something of an increased enlargement, until finally there has developed what is known as elephant leg.

Prevention.— Very greatly reduce the grain ration during the idle period.

Treatment.— Hot fomentation over the swollen part, to be continued for several hours. Between the periods of fomentation there should be given vigorous friction, rubbing upward, and long continued light exercise—if the horse is able to walk at all. The horse should be kept walking about slowly for several hours at a time. During the first three or four days, and until the active symptoms abate, the food should be light, laxative and later on the horse may be returned to full feed.

HEAVES.

Definition.—A disturbance of the process of respiration, characterized especially by easy inspiration and difficult expiration, the latter being accomplished by two distinct movements. It is usually conceded to be an indirect result of a disturbance originating in the stomach, and affecting the lungs through the pneumogastric or tenth cranial nerve, from which nerve both these organs receive a portion of their nerve supply.

This disease very materially lessens a horse's value and usefulness. Horses so affected are often unthrifty by reason of chronic indigestion. Light feeders are usually free from this disease. The air vesicles are gradually dilated, losing their elasticity, and even rupturing together so as to produce small cavities from which the air is expelled with great difficulty. The air may in this way escape into the interlobular tissues.

Cause.—Generally conceded to be a reflex disturbance through a stomach branch of the tenth cranial nerve, which nerve also supplies in part the heart and lungs. We may say that the direct cause of this disease is *excessive eating* of bulky food, especially hay that is over ripe and dusty. Tame hay that is cut very ripe, and dusty clover hay are both prone to cause this trouble. Heaves rarely, if ever, develops on horses in pasture or that have only wild hay, or reasonable quantities of early cut tame hay.

Symptoms.—A peculiar explosive cough usually appears before respiration is much disturbed. Later on it is noticed that exercise produces marked difficulty in breathing, the inspiration being quite normal and the expiration being difficult. The air is expelled in two efforts, the latter portion of the tidal air being expelled by a special effort of the abdominal muscles. Over feeding increases the difficulty. Some cases of heaves may be disguised temporarily by the use of drugs and feeding on concentrated food. The trick may be detected by allowing the horse a hearty feed and then giving violent exercise, or even by the exercise without the special feed.

It is usually easy to distinguish between heaves and roaring. The latter is a disorder of the larynx due to paralysis of one of the laryngeal cartilages. It is shown by the abnormal sounds

known as roaring or whistling, the respiratory movements of flank and chest being normal in character.

Prevention.—Feed reasonable quantities of good wild hay or tame hay cut early. Avoid dusty foods. The amount of hay should be restricted and if necessary more grain may be used. Horses that are greedy feeders should be bedded with sawdust or shavings, or protected by muzzle.

Postmortem.—On examination postmortem the lungs are found to be rather bloated and to contain more air than is normal. The chambers in the right side of the heart are somewhat enlarged and the walls thickened.

Treatment.—Avoid over-ripe hay. Avoid much bulky food of any kind. If hay or grain is at all dusty sprinkle. Use horses affected with heaves for slow work. Medical treatment is considered to be unsatisfactory.

LECTURE XL.

CHOKE.

Explanation.—Choking, as ordinarily understood, is an obstruction in any portion of the pharynx or esophagus. In horses this is more commonly caused by dry food, and this usually occurs in the case of horses which are rapid eaters. Cows more frequently choke on pieces of roots, pumpkins and old bones. Those cases where a long section of the esophagus is packed with soft, dry food, are especially difficult to handle successfully.

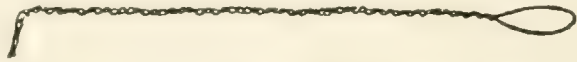


FIG. 61. FOR RELIEVING CHOKES. (M. H. R.)
Made of No. 10 or 12 wire.

Symptoms.—The horse or cow stops eating suddenly and makes ineffectual efforts to swallow, then there are spasmodic actions of the neck muscles. When the animal attempts to drink the water returns partly through the nose. If the obstruction is of considerable size and along the neck portion of the esophagus, it may usually be seen or felt. There is usually a profuse flow of saliva, and particularly in the case of cattle an involuntary chewing action. If the choking occurs in the thoracic portion, then medicines or liquids are swallowed in small quantities without difficulty until the esophagus is full and return by the mouth, the animal being apt to cough. There is usually marked dejection and distress, with an appearance of anxiety. Food and water are refused. Cattle frequently bloat.

Prevention.—Roots should either be sliced or pulped. It should be borne in mind that cows usually choke when eating hurriedly especially when attempting to swallow something under threatened attack from some other member of the herd. Horses choking on dry feed are almost invariably rapid eaters and for such horses it is well to avoid dry bran. The grain, especially

oats or similar food, should be given in such a way that the horse must get it slowly. Several large stones may be placed in the feed box, or the grain may be scattered over the bottom of a large manger. Any device which will force the horse to eat slowly will avoid the difficulty in normal cases. It should also be borne in mind that an animal which has been choked is very liable to have a recurrence of the same difficulty during the first week or two after the accident—on account of dryness with inflammation and irritability of the gullet.

Treatment.—If the obstruction is within reach it should be removed by the hand, the teeth being held apart by some suitable device to protect the arm. A person with long arm and slender hand can frequently relieve choking in the pharynx or upper portion of the gullet, especially with an assistant to shove the obstruction upward toward the hand.

By coughing.—Dry food that can not be reached by hand should be softened by the use of oily or mucilaginous drinks, and then gradually worked loose by manipulation. A small portion may be loosened from the upper end of the obstruction and the animal may be induced to cough it out. Then another drink is given and the manipulation and cough are repeated. Frequently the obstructing mass can be loosened at the lower portion, and the loosened portion swallowed. The simple device of forcing the horse to drink enough to fill up the upper portion of the esophagus may be resorted to, then the horse will usually cough violently—expelling a portion of the obstruction. In case the horse does not cough he can be induced to do so by pinching the larynx and releasing suddenly. In this way considerable portions may be removed by each coughing. Probang should not be used in cases where the choke is due to dry food.

Mechanical means.—Solid bodies, like pieces of roots, may be either shoved down to the stomach, or drawn upward by means of a cork-screw probang. The probang consists of a smooth flexible tube of suitable size, with a central rod, upon the end of which there is placed (in some makes) a sort of cork-screw. This is withdrawn into the tube during introduction, when the end of the probang touches the obstruction the central rod is shoved forward and the cork-screw worked into the root or whatever the obstruction may be. If the obstruction fails to withdraw it is at

least broken up and softened to some extent every time the cork-screw is introduced.

The simple device shown in figure No. 61 is very satisfactory for relieving cases of this kind. It consists of a piece of No. 10 or 12 wire, about 12 feet long; the ends bent together and twisted as shown in the cut, leaving a suitable loop at what was originally the middle of the wire. This is introduced into the gullet like a probang. The farther end passes the obstruction, which is then included by the loop; the wire is withdrawn and the obstruction is loosened, moved upward a short distance or removed entirely. If the instrument merely loosened the obstruction, then the process is repeated. This has proven most satisfactory in the writers experience. In all work of this kind the nose should be extended and the gullet kept in as straight a line as possible.

The *probang* or wire loop should be introduced slowly and carefully. If the animal coughs the instrument should be removed and another trial made, as the coughing indicates that the instrument has entered the trachea. The introduction and after use of these instruments must be very gentle and cautious.

Whole eggs that have been partly swallowed may be punctured by a large needle and then easily crushed.

Tense, spasmodic action of the gullet may be controlled by the use of morphine or aconite.

Whips and other stiff rigid instruments must be avoided, as they are very apt to tear the gullet just below the pharynx. Whatever is used must be smooth and flexible. The after treatment consists of soft food, for at least a week.

LECTURE XLI.

HOVEN OR BLOAT.

Definition.—A form of indigestion in cattle and sheep characterized by an abnormal collection of gas in the first stomach or paunch.

Causes.—Sudden changes from dry food to pasture or from one pasture to a better one; or from grass to clover. Grasses or clovers seem more apt to cause hoven when the dew is on, or after a rain. Frosted roots and impaction from over-feeding may also result in arrested digestion, and then hoven ensues.

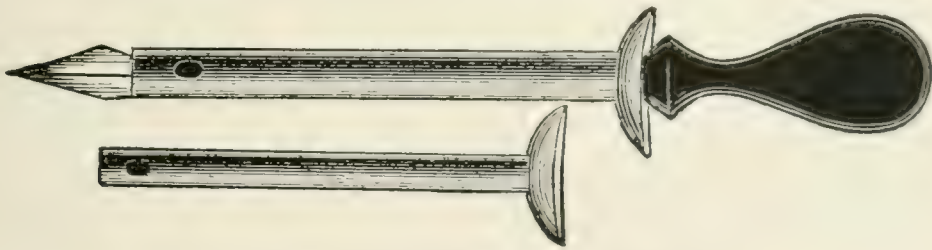


FIG. 62. TROCAR AND CANNULA.
For tapping bloated sheep and cattle.

Why cattle and sheep are more apt to bloat when the dew is on the grass, or after a rain, may perhaps be explained in this way: The grass is more palatable and also heavier, the cattle eat more rapidly; more air is swallowed with the food and they eat more than at other times. This larger quantity of food that is so heavy, makes such a large and heavy mass in the stomach that the involuntary fibres are partially paralyzed. By reason of the weight and stretching, digestive processes are checked and fermentation goes to excess. Gas accumulates until the stomach may be greatly distended.

Symptoms.—Extreme distension of the stomach; which is most prominent on the left side, and difficulty of breathing. The pulse may be nearly imperceptible. The animal moans; may stagger and fall then die in convulsions.

Treatment.—If breathing is difficult, do not wait for the effects of medicines, but tap with trocar as shown in class, high in left flank and well forward. See fig. 63. The tube may be left in some time if gas continues to accumulate. Then give the following as one dose in $\frac{1}{2}$ pint of syrup:

- (A) Aromatic spirits of ammonia.....1 oz.
 Turpentine1 oz.



FIG. 63. SHOWING WHERE TO TAP. (M. H. R.)
 See white cross in the flank.

Repeat every half hour until gas ceases to accumulate or until 6 doses have been given if necessary; or (B) give 4 oz. hyposulphite of soda in 6 oz. water every half hour until gas ceases to accumulate or until a limit of 6 doses have been given; or (C)—give (A) and (B) alternating, one-half hour apart. Do not exercise the cow or sheep when badly bloated. This is dangerous because the breathing is so greatly interfered with by the pressure of the stomach against the diaphragm. When the acute symptoms have subsided give the following for physic:

- (D) Epsom salts1 lb.
 Glauber salts $\frac{1}{4}$ lb.
 Common salt $\frac{1}{4}$ lb.
 Ginger (ground)3 oz.
 F. c. nux vomica.....3 drams.

Dissolve (D) in three pints hot water and give as a drench—repeat in 16 hours if bowels do not move freely.

Prognosis.—A large proportion of cases recover when properly treated soon after disease appears.

Prevention.—A large proportion of these cases may be prevented but hoven will appear occasionally under conditions which cannot be prevented. Avoid as fully as possible the conditions that have been cited as causes. There are two methods of turning cattle and sheep on new pasture in the spring or at any season; from one pasture to a richer; or from grass to clover, with reasonable safety. *First*—Turn them on but a few minutes the first day and increase this time each day for a week. *Second*—Give the cattle or sheep a large ration of the dry food, to which they have been accustomed, on the evening before they are to be turned on; repeat the large ration of this food the next morning, feeding much later than usual and then turn them out, soon as done eating, which should be after the dew is off the grass and not soon after a rain. Under these conditions cattle and sheep may be turned on grass in the spring or on new or different pasture with little risk. Never make such change when the grass is wet from dew or rain. Pastures where the old grass stands quite heavy on the ground and the young grass grows up in such a way that the stock must eat the two together, are much less dangerous than those where the stock gets only the new grass.

Causes of death.—There is usually carbonic dioxide gas poisoning; sometimes actual suffocation; frequently rupture of the stomach or diaphragm.

LECTURE XLII.

LAMENESS.

Definition.—Any irregularity of the gait, regardless of cause or degree.

Locating the lameness.—It is usually quite easy for any observer to recognize that an animal is lame, provided the lameness is at all decided, but there are many cases where the lameness is so very slight that it is difficult for an expert to locate it or even be sure that the animal is lame.

Side.—A very common error is that of locating the lameness on the wrong side. This is easily avoided if one remembers that the head and weight of the body in general come down most noticeably with the sound limb. For instance, a horse being lame in the left front leg will drop very evidently as he lands upon the right front leg.

Gait.—Some forms of lameness are detected with great difficulty when the animal is walking, but are easily seen when the horse is trotting. It is usually conceded that the latter is the best gait for diagnostic purposes, although the observer should study the movements at both walk and trot if possible. The pacing gait is rather confusing.

The test.—The animal should be tried on both hard and soft ground. If the lameness is in the foot the lameness is most marked when the animal travels on hard ground. On the contrary, when a horse is lame in the shoulder he is apt to travel with great difficulty in deep mud or in snow.

General examination.—The horse should be examined unblanketed in the stall, making him step from side to side, and noting how he stands at rest. Then the horse should be taken out and observed while walking and trotting, coming toward, passing by and going from the observer, the latter observing carefully the movements of the entire body and the use of each limb. It is especially important to observe the head and hips in solving the first problem of locating the diseased limb.

It should always be borne in mind that the foot is an especially common seat of lameness.

FROM BONE DISEASES.

Bony growths.—Splints, spavins, ring-bones, etc., are simply developments of bone tissue, the result of an inflammation of the periosteum. These are all recognized as forms of unsoundness and usually cause lameness. This inflammation may have its origin in bruises or other injuries, or possibly the inflammation in this tissue may be the result of an extending inflammation from some adjoining tissue, but in any case the result is a projecting development of bony tissue.

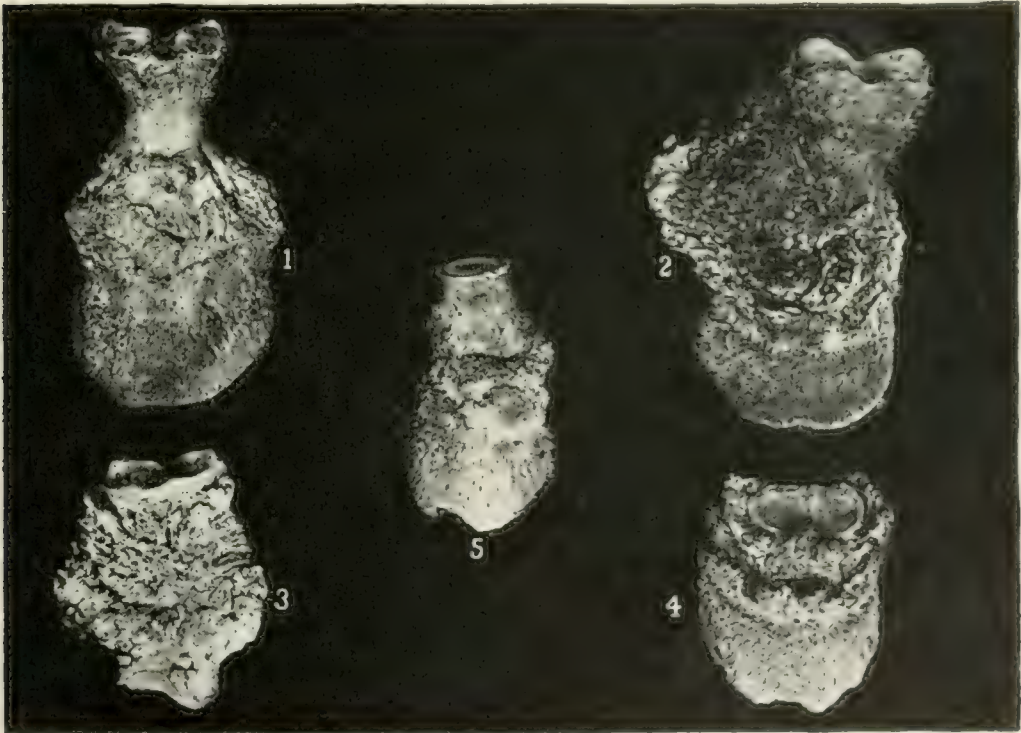


FIG. 64. RINGBONES. (M. H. R.)

- 1, Ringbone and sidebone, with general ankylosis.
- 2, Ringbone and sidebone, with general ankylosis and marked bony enlargement.
- 3, High ringbone with ankylosis of first and second phalanges.
- 4, Low ringbone with sidebone, and ankylosis of the second and third phalanges.
- 5, Ringbone with sidebone, and unilateral ankylosis.

Splints.—These appear as small tumors along the metacarpal bones usually at the junction of the large and small metacarpals. They may be of various shapes and sizes, but are usually small. They are generally more serious when located near the knee.

Occasionally there appears what is known as a pegged splint, in which the growth extends across the back of the cannon, beneath the suspensory ligament.

The *lameness* which results from splints is rather easily recognized, first, by locating the splint, noting the sensitiveness on pressure over this point. A peculiarity of the lameness is that the horse walks nearly or quite sound, but trots very lame, especially on hard ground.

There is a natural tendency to recover. Lameness from splints is rarely seen in aged horses for this reason.

When the splint appears very close to the knee, or in the pegged form there is less prospect of natural recovery, and with the latter form lameness is very apt to be permanent, unless relieved by surgical means.

Ringbone.—This is characterized by enlargement of some portion of the pastern bones. It may be in front, behind, on either side or extending entirely around this region. It may be located near the crown of the hoof or very much higher, and we thus have ringbone divided artificially into two classes, high and low.

Ringbones are very much more serious forms of unsoundness than splints, as they are more apt to be permanent in effect and even if the soreness be relieved there is liable to be a mechanical lameness because of a stiffened joint. This unsoundness and the lameness resulting from it are very easily detected.

Sidebones.—Sidebones is an abnormal condition of the lateral cartilages, characterized by a firmness under pressure of these cartilages—which should be quite elastic. The firmness is due primarily to a deposit of lime in the cartilage structure. Sidebones are detected as bone-like structures which appears above the crown of the hoof and just beneath the skin on either side. They usually cause lameness during the period of inflammation and hardening. In some cases the lameness is persistent.

Spavin.—The cause of lameness which we recognize under the name of bone spavin is an abnormal condition of the tarsal bones at the lower, inner, front portion of the hock. There is usually something of an enlargement, varying from a very small growth, commonly called by horsemen a jack, to a very large growth which every one recognizes as bone spavin.

There is another form of bone spavin in which there is a slight or possibly no external development at all. In this form of spavin there may be diseases of the bones in the deeper parts; particularly erosions of the articular cartilages. Bone spavins have a tendency to recover without treatment, although in many cases the period required for natural recovery is very long, extending through a period of years. In other cases recovery can never occur. Recovery when brought about by natural or artificial conditions implies that certain of the tarsal bones have united in the process called technically, ankylosis, and the inflamed surfaces are no longer rubbing together as the limb moves.

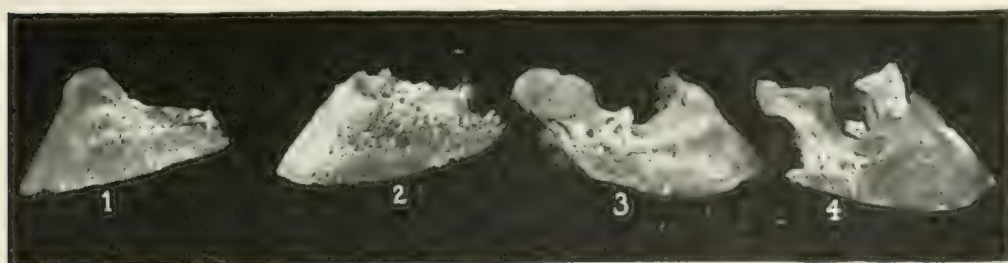


FIG. 65. SIDEBONES. (M. H. R.)

Due to an inflammation and ossification of the lateral cartilages. 1, Normal os pedis; 2, 3, 4, varying types of sidebones.

Many bone spavins doubtless appear as the result of slight injuries in susceptible subjects, particularly those that have a strong hereditary tendency to diseases of this kind.

Bone spavin is one of the most serious forms of unsoundness of the organs of locomotion.

Symptoms.—A spavined horse steps on the toe, and carries the hock joint with as little movement as possible. The lameness usually disappears or at least greatly improves with exercise.

What is known as the *hock test*, is made by holding up the limb with the hock sharply bent, for several minutes. Then the horse is started suddenly. In case of spavin the first few steps are very lame. Old horses without spavin may respond to this test and lead to error if one is not careful.

FROM SYNOVIAL MEMBRANES.

Synovial sacs.—The ordinary wind puffs of the ankle, and bog spavins and thoroughpins at the hock are typical illustrations of enlarged synovial sacs. They are not usually the cause of lameness, but are to be regarded rather as symptoms.

Wind puffs usually indicate considerable amount of hard road work.

Bog spavins.—These are enlargements of the synovial sac of the hock joint and appear at the inner and front part of the hock. They are often hereditary.

Thoroughpins are very similar to bog spavins and wind puffs, except in location. Thoroughpins appear at the upper and back part of the hock. They may or may not connect with the synovial sac of the hock joint.

Open joint.—Lameness from open joint is quite common among city horses. This usually results from punctures of the synovial sacs and the entrance of foreign matter, resulting in an acute inflammation or synovitis. This form of lameness can usually be very easily detected, and the cause recognized. It is very serious under all circumstances and frequently results in loss of the animal.

Curb.—This is a result of an injury or strain at the back of the hock joint and is characterized at first by a hot, sensitive swelling just back of the lowest part of the hock joint. After the period of swelling and inflammation subsides there is apt to remain a hard tumor, particularly on what is known as curby hocks. In cases of young animals given proper treatment the remaining enlargement may be very slight or may practically disappear.

Capped hock.—Capped hock is not usually a cause or condition of lameness; but is mentioned at this place for other reasons. This is an unusual prominence at the point of the hock and produced by bruises. Some horses get it by backing up against the stalls and striking so as to injure the point of the hock. Other cases are produced in car shipments. In other cases there seems to be a natural tendency and the disorder is brought about by very slight injuries. The first swelling may usually be reduced by prompt treatment, but it returns with very slight injury and after several attacks is apt to be permanent. This does not injure horses for actual use, but is unsightly and materially reduces the sale value.

LECTURE XLIII.

SOUNDNESS.

If at the time of sale a horse has any disease which either actually does diminish the natural usefulness of the animal so as to make him less capable of work of any description, or which in its ordinary progress will diminish the natural usefulness of the animal, this is unsoundness. Or if the horse has, either from disease or accident, undergone any alteration of structure, which either actually does at the time or in its effects will diminish the natural usefulness of the horse, such a horse is unsound. (An old English-law definition).

Unsoundness.—The above is a very comprehensive definition but soundness is usually relative, rarely if ever absolute or perfect. What we mean in passing a horse as sound, is that he is practically sound.

Definition.—To be theoretically sound a horse must have no disease or other condition that interferes or is likely to interfere with his usefulness, or injure his selling value. For instance, a horse may have a spavin which both lessens his ability to work and injures his selling value. The same would be true of heaves. A horse may have a disease from which he will recover. At the time of the examination he will be technically unsound.

Unsoundness may be temporary or permanent. Temporary unsoundness may be illustrated by an influenza, from which a horse would probably recover, or light sprains, or a bruised ankle—from interfering. In the latter case the question would arise at once as to whether the interfering was due to faulty conformation or to faulty shoeing for the latter could be easily remedied. In the former case the condition would be serious; in the latter condition it would be unimportant.

Normal conditions.—It is necessary first of all to get familiar with the usual normal and unusual normal conditions and appearances for comparison. For instance, the hocks may be perfectly sound, and yet have peculiar bony development. In such cases

it will generally be found that both hocks are alike. The knees may have similar peculiar development, and yet be perfectly sound.

Examination.—An examination for soundness should be systematic and thorough, although it may be rapidly done. Examination should be made with a horse in the stall; as he backs out, stands at rest and in motion. In the stall to see whether the horse cribs or weaves, or has any other stable habit which is objectionable. As the horse backs out of the stall he may show peculiar use of the hind legs or imperfect control, due to serious disorders of the nervous system. Very frequently the first intimation of spavin may be had as the horse is made to step from side to side, particularly as he steps toward the spavined leg.

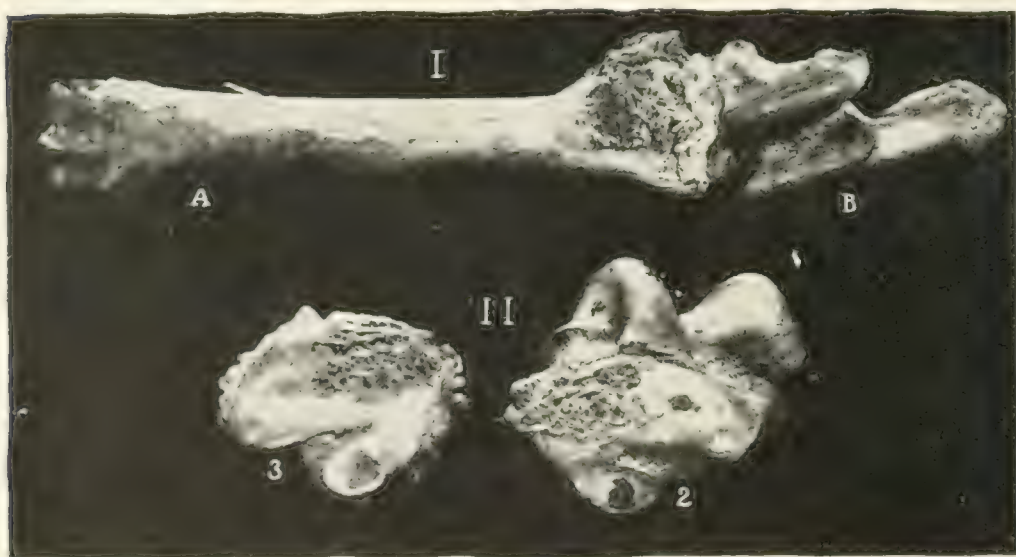


FIG. 66. SPAVINS. TWO TYPES. (M. H. R.)

I. Spavin with Marked Bony Enlargement. A, Metatarsals; B, tarsals with enlargement and ankylosis.

II. Blind Spavin. Extensive ulceration of articular surfaces; no enlargement; no ankylosis. 2, Os calcis; 3, scaphoid or large cuneiform.

At rest.—With the horse at rest the observer should begin in front and examine the *ears* for hearing, for tumors that may develop around the base, for split ears, etc.

The *eyes* should be examined to test the sight, bearing in mind that moon blindness, which recurs at intervals and leaves the eye more or less nearly normal between times, still shows a weakened or quivering appearance that is suggestive.

The *nasal chambers* should be examined for ulcers, scars, or discharges which would suggest possible glanders, bearing in

mind that dishonest dealers sometimes plug the nostrils with a sponge to prevent the appearance of suspicious discharge.

The *teeth* should be examined for evidences of cribbing, for age, and for a condition commonly known as parrot-mouth which interferes with a horse feeding in pasture.

The *lips* should be examined for evidence of paralysis. The *glands* under or rather between the portions of the lower jaw should be examined particularly with reference to glanders.

The *poll* should be examined for scars or other evidences of present or previous poll evil.

The *withers* should be examined for scars, for discharging sores and other evidences of fistulous withers.

The *shoulders* should be examined for sore neck and particularly so-called collar boils. The latter are either flat and broad or more prominent tumors, which will usually subject a horse to sore shoulders whenever he is put to work.

The *elbow* should be examined for shoe-boil; the *knee* for what is commonly known as broken knee, which indicates that the horse is inclined to stumble, and also for what is known as knee spavin.

The *cannon* or shin-bones must be examined for splints, and behind them the tendons must be examined for evidences of sprains and other injuries which are usually indicated by a thickening of the parts.

Ankles are to be examined for evidences of interfering, and fractures or other injuries of the sesamoid bones and attached ligaments. The region of the *pastern* is to be examined for ring-bones, fractures and evidences of the operation known as nerving. Evidences of this operation are found in scars about midway of the pastern on each side, just at the edge of the back tendon. The sides of the back tendons should also be examined just above the ankle for scars, which would suggest another nerving operation. The mere fact that a horse has been nerved, whether going sound at the time of examination or not, is a very serious objection. This operation is not usually resorted to except as a measure of last resort, and it does not in any sense cure the original disease.

While passing along the side and flank the *breathing* should be observed, as to whether it is even and regular; or jerky, sug-

gesting heaves. The flank and lower part of the abdomen must be examined for possible ruptures.

Stepping behind the horse the two *hips* are compared for evidences of fractures, or what is commonly known as *hipped* or *hip-shot*. This disorder does not interfere seriously with the horse's working ability, but gives the horse a very awkward appearance and materially lessens the selling value.

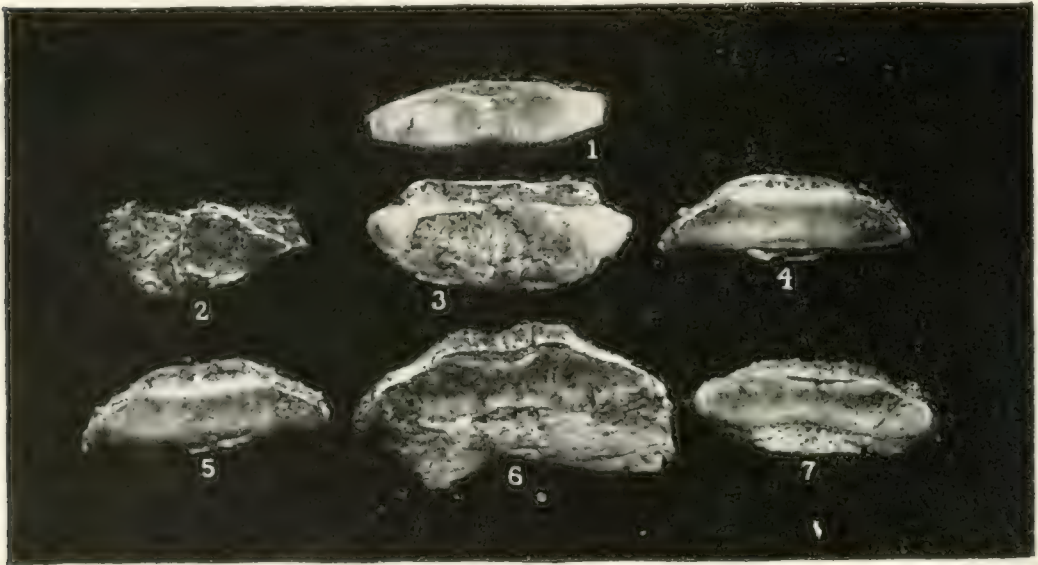


FIG. 67. NAVICULAR DISEASE. (M. H. R.)

1. Normal navicular bone.
2. Exostosis (bony enlargement) with fracture.
3. Exostosis with extensive ulceration of the articular surface.
- 4, 5, 6, 7, Varying types of exostosis.

The *hocks* must be examined for bog and bone-spavins, thoroughpins, and curbs; and the point of the hock for what is known as capped hock. The same examination is made of the cannon, ankle and pastern as for the front limbs.

The *feet* should all be examined for evidences of contraction at the heels; for flatness or convexity of the sole, founder, navicular disease, and other diseases of the feet which are easily recognized. Among these should be named quarter and toe-cracks, and serious injuries to the crown of the hoof by sharp caulks.

In motion.—The horse should be examined while walking and trotting. The movements of the neck and head are studied as he comes toward the observer; then, as he passes by the movements of the limbs are noted as to the height to which they are raised; the bend of the joints, whether easy and natural or otherwise. The way in which the foot lands upon the ground, whether

flat, on the toe, one side, or on the heel is important. As the horse passes from the observer the movements of the hips and hind legs are noted with a view to detecting lameness in those parts. Examination in motion on hard road or pavement should be made, especially to bring out diseases of the feet. Then motion in deep mud, or in snow should be studied. Failing these, he should be made to step over a rail or plank held up about a foot from the ground in order to detect or make more prominent possible soreness or lameness in the shoulder or hip.

The lungs.—Finally, the horse should be given vigorous exercise. For instance, a run to a heavy wagon, or a short run up hill to determine whether the lungs are normal, or in other words, for the purpose of testing his wind. It is possible to partially disguise abnormal breathing while a horse is at rest, but it is practically impossible to do so if the horse is given violent exercise and the latter should preferably be done after feeding and watering.

COMMON FORMS OF UNSOUNDNESS.

The most common and obvious forms of unsoundness are: Bad eyes; glanders shown at the nose; poll evils just back of the ears, at the top of the neck; fistula at the withers; heaves, shown in breathing; splints, along the cannon; injured tendons; farcy sores on limbs or body; bruised ankles from interfering; sidebone and ring bones at the pastern; navicular disease, corns, founder, cracks, etc. at the foot; fractured hip (hip shot); spavin at the hock in front and curb at the hock behind.

LECTURE XLIV.

LAMINITIS.

Definition.—This is a painful and rather frequent disease of horses,—commonly called founder. It is essentially an inflammation of the sensitive parts within the hoof, and takes its name from the sensitive laminae. The third phalynx is frequently involved.

Symptoms.—The horse usually persists in recumbent position. There is unmistakable evidence of soreness in the affected limbs, coupled with symptoms of extreme pain. The respiration, pulse and even the temperature may be increased as a direct result of the great pain. If the disease affects the front feet, the horse carries as much of the weight as possible upon the hind feet, with the two front limbs projecting forward. If the hind feet are involved, the horse stands with the two front feet back under the body, carrying as much weight as possible, with the two hind feet extending forward so as to relieve the sensitive toes from pressure.

Cause.—Laminitis results from profound disturbances of the circulation. The unyielding horny box does not permit expansion of the inflamed tissues, hence the great pain that is invariably manifest in this disease. This disorder may have its origin in an unusual over feeding; or in a large quantity of very cold water taken when a horse is very hot or tired. It may be a result of forcing a horse to stand on hard footing for a long time. It sometimes occurs in one front foot, or one hind foot, as an indirect result of lameness in the opposite limb. The horse overworks the sound limb in order to relieve pain in the previously lame one, and thus causes laminitis in the foot which had previously been sound. Laminitis not infrequently results as a transfer from a pneumonia or bronchitis; sometimes from inflammation of the bowels, and apparently without other direct exciting cause.

Pathology.—There is first of all an inflammation of the sensitive parts within the hoof, especially the sensitive laminae. This

is followed by an exudate which may be either slight or considerable in amount and more or less persistent. In persistent cases, with considerable exudate, the toe of the os pedis (third phalynx) is gradually pressed downward against the sole. The sole may gradually become convex and the horse becomes permanently unsound.

Termination.—Laminitis may terminate in recovery and practical restoration of the affected parts, or there may remain a convex sole and a chronic soreness with a tendency for the hoof to grow in an unnatural shape, see figure 68. The wall becomes wrinkled transversely, and grows unevenly.

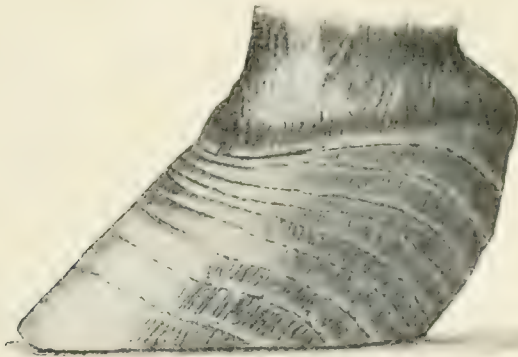


FIG. 68. A FOUNDERED HOOF.
(B. A. T.)
An old case.

Treatment.—These are usually serious cases and should always have the benefit of professional attendance and skill if such is obtainable. Any treatment that could be suggested might be unwise in some cases, and unwisely applied in others.

A treatment that is frequently satisfactory, consists in keeping the feet in cold water for a long period of time, several days if necessary. Sometimes this may be done by standing the horse in a shallow stream, preferably with a soft bottom. When a horse must be kept in the stable he should have a large box stall with deep, soft bedding. If he is compelled to stand for any great length of time in order to keep the feet in cold water, then he should be supported by a sling. Severe cathartics should be avoided—but it may be desirable to give mild doses of aloes, or Epsom salts. A dose of the former for this purpose would be one-half ounce or less; the dose of the latter would be about one-fourth pound, either repeated as necessary. Coupled with this

one ounce of saltpetre may be given, dissolved in drinking water, or as a drench three times daily. Ordinarily the shoes should be removed. The toe, if long, should be shortened, but the sole should not be thinned or otherwise interfered with. If the horse is compelled to stand he may stand more comfortably with shoes that are high in the center and rocking backward toward thin, flat heels. If the pain is extreme, and not controlled by the resting upon soft bedding and continuous application of cold water, then some preparation of opium should be given—as a matter of humanity if for no other reason. The dose of laudanum is about one ounce, and may be repeated two or three times a day, if necessary to control the extreme pain.

LECTURE XLV.

PARTURIENT PARALYSIS (MILK FEVER)

Causes.—Predisposing, and precipitating.

Predisposing.—Age (maturity) heavy feeding and milking qualities, pregnancy, easy delivery, lack of exercise and consequent lack of physical wear, high temperature in stables.

The cow that is in the prime of life, with her third or fourth calf and that is a heavy feeder and milker is the one most subject to this disease. Cows in thin flesh, that have been under fed during pregnancy, are not liable to have this disease. Neither are young heifers nor old cows.

Precipitating.—Delivery, injury to genital organs sudden increase of gland activity in the udder, costiveness (both as cause and result) ; anxiety ; exposure to cold and damp.

Schmidt's theory is that certain chemical poisons are formed in the udder, absorbed into the blood and circulated throughout the body, reaching the brain and spinal cord through the general circulation, and producing the general symptoms of paralysis of sensation and motion. Dr. Schmidt has noticed that the greatest mortality occurs when the disease appears very soon after birth, and incidentally that is the period of most abundant colostrum in the udder. If the poisons develop very rapidly and absorb rapidly into the blood, the animal may die suddenly ; if they develop slowly, they may be gotten rid of by being neutralized or excreted. According to Schmidt's theory, this disease has its origin in an unusually large secretion of colostrum and the poison is a product of chemical decomposition of the colostrum. Chemical composition of the poison is probably variable, as the poisonous effect seems to vary. Cows brought to the highest state of milk production pass the limit of physiological conditions, and are very easily disturbed by taking cold, abundant diet, excessive quantities of water or digestive disturbance (Schmidt).

Symptoms.—Early or warning, and diagnostic or positive.

Early.—Uneasiness, sudden constipation, eyes stupid or wild, tail switches uneasily, milk flow checked. Such symptoms should warn of danger, if occurring during first five days after calving, or within two days before.

Diagnostic.—Patient goes down; loses sensation and voluntary motion; pupils dilate; cow lies in a peculiar position with head in flank; unable to swallow; pulse at first bounding and full—later depressed.



FIG. 69. PARTURIENT PARALYSIS—MILK FEVER. (M. H. R.)
Early stage. Unsteady on hind legs.

Nervous disturbance.—Two types, torpid; and nervous or violent. May be torpid at first and later change to nervous; both are apt to terminate by slow collapse.

Prevention.—This is always more satisfactory than treatment and is especially applicable to milk fever. For a heavy milker, sudden changes in diet should be avoided. Any change should be toward one lighter and more laxative. It is sometimes advisable to put up from pasture on to light, dry feed. Food should be light, laxative, easily digested, and small or moderate in quantity. A mild laxative (a) may be given 2 to 5 days before calving, and a cathartic (b) within 12 hours after calving. For (a) give one quart raw linseed oil. For (b) 1 to 2 pounds of Epsom salts with

2 to 5 ounces powdered ginger, dose depending on size of cow and condition of the bowels. Allow cows abundant exercise during the last month of pregnancy and if a cow is nervous, leave the calf with her for a few days.

Treatment.—These cases require the highest skill in treatment, and the affected animals are usually valuable. For these reasons *stockmen should not attempt to treat these cases if competent veterinary services may be had.* A line of treatment is suggested here only because cases often occur where it is not possible to obtain professional assistance.



FIG. 70. PARTURIENT PARALYSIS. (M. H. R.)
Later stage. Head held unsteadily.

The patient must not be allowed to lie flat on the side, but should be propped up by means of bags of sand, bran or hay, so that she lies on the sternum. If the head is thrown around violently, it should be supported by means of a rope tied to some overhead support. The cow must also be kept thoroughly warm and dry. Equalize circulation by vigorous applications to skin; e. g., mustard and turpentine. Retain heat in cold weather by 4 or 5 blankets. Preserve quiet; draw urine twice daily with catheter, and use large quantities of slightly irritating rectal injections repeated several times daily, if necessary. Use alcoholic preparations and nux vomica for stimulants and tonic effect.

Give every two hours alcohol, 1 to 3 ounces; f. e., nux vomica, 3 drams (3 teaspoons) in eight ounces of syrup. Repeat until cow shows signs of nervousness. Use the nux vomica also in later stages if motor paralysis remains, after acute stage has passed. Beware of choking for these patients cannot swallow safely after the disease has made much progress. Test first with plain water the ability to swallow easily.

The most recent and successful treatment is injection of potassium iodide solution into the udder through the teats. This is known as Schmidt's treatment.

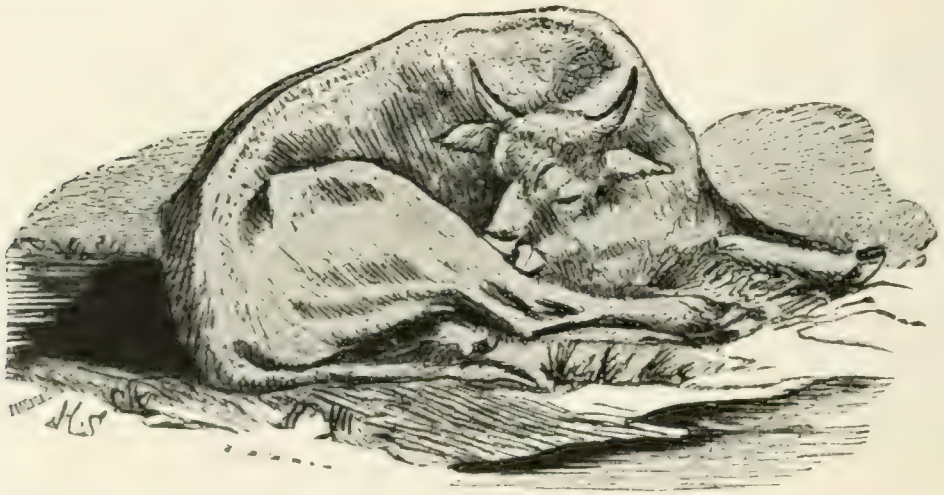


FIG. 71. PARTURIENT PARALYSIS.

Cow very stupid. Skin has lost sensation. Head in the flank. Still later stage.

Schmidt's Treatment is directed to the local seat of trouble; i. e., the gland cells and milk ducts, and may be used in connection with the preceding.

About $2\frac{1}{2}$ drams iodide of potash are dissolved in one quart of boiled water. One-fourth of this is injected by means of a syringe or by means of rubber tubing and a milk tube through each teat into the udder. Each quarter is thoroughly milked out just before the injection is made. The solution should be injected at about 105-8 F., and left in the udder. It should be borne in mind that the solution cools several degrees during injection. The temperature should not be guessed at. It can be determined accurately by means of a dairy thermometer.

Treatment may be repeated in 12 or 24 hours if needed, cow

in the meantime being carefully treated as to position, etc., as already suggested.

Prognosis.—Difficult to make an accurate estimate. Sudden and unexpected variations occur. Average loss under the Schmidt treatment is not large. Unfavorable if: Case develops soon after calving; it develops rapidly and seems to overwhelm the system; decided loss of animal heat; tympanites or bloating; convulsions; cornea becomes insensible; lower lip hangs loosely.

Favorable if: Circulation remains good; feces are passed; patient attempts to rise or eat; slight fever while circulation is still weak; if rectal or vaginal irritation causes a discharge of feces or urine.

LECTURE XLVI.

SAND COLIC.*

Occurs in horses, mules, and cattle. Especially common in portions of the South.

Organs involved. —*In horses* the sand may be in the stomach, the small intestines and in the large intestine (caecum and colon). The sand accumulates most frequently in the caecum and large colon.

In cattle the sand may be found in any of the stomachs and the intestines. Dieckerhoff says the sand accumulates usually in the second and third stomachs, and small intestines (duodenum). Harms claims that it collects in the second and first most frequently.

Causes.—Drinking in shallow water and sucking up the sand with the water; grazing in short, sandy pastures; eating sanded hay, fodder or grain; and the habit of eating dirt, or eating grain from the ground.

Symptoms.—Chronic indigestion; periodic attacks of colic and diarrhoea; passing of sand; obstruction of the alimentary canal (impaction). In cattle the loss of appetite; suspension of rumination; fermentation and bloat; impaction with obstruction of the intestinal canal; and oftentimes chronic indigestion attended by emaciation, and in cows decrease of milk flow.

Diagnosis.—Sometimes sand may be observed in the feces. Rectal exploration may enable one to feel the sand in the colon or caecum. It is difficult to distinguish this disorder from chronic indigestion, and from the impactions and intestinal calculi. Positive diagnosis in some cases is impossible.

Prognosis.—Many cases are fatal.

Treatment.—Remove the cause. Massage of the abdomen; rectal injections of large quantities of warm water; flooding the

*Contributed by Dr. C. A. Cary, Alabama.

stomach and intestines per stomach tube with warm water (Dieckerhoff for cattle) ; laxative food, raw potatoes, green feed ; oleaginous purgatives in either large doses or frequent small doses ; and in some cases barium chloride intravenously or per mouth. In extremely painful cases it may be advisable to use morphine, chloral or cannabis indica, but as a rule it is best to avoid these drugs.

LECTURE XLVII.

SHEEP SCAB.

Sheep scab is a result of irritation caused by little animal parasites as they burrow tunnels into the skin or puncture it from the surface. There are three types of these mites and three types of the disease which they cause. One variety of these mites produces body scab, another produces head scab, and a third produces foot scab.

BODY SCAB.

General history.—This is the most common and serious type of sheep scab, because it spreads most rapidly over the individual body, and also spreads most rapidly through the flock.

This disease appears insidiously, and is liable to become quite serious before being noticed by the owner. The parasites which cause this type of the disease do not tunnel into the skin, but they cause intense irritation by reason of their presence and mode of life beneath the scabs. The owner will usually remember, after he has become aware that body scab exists in his flock, that his sheep have seemed uneasy and some of them have been rubbing and biting themselves occasionally for some time.

The parasites live beneath the crusts after the disease is well under way, and constantly migrate outward, while the skin slowly heals in the center. The fleece of scabby sheep is usually rough, the wool is matted in places and easily rubbed off. The parasites which cause this form of the disease confine their work almost exclusively to parts of the body where the wool is long and thick.

How spread.—This form of the disease spreads rapidly through the flock; partly because of the location of parasites upon the body of the sheep, and partly because of the freely moving habits of the parasites. As a rule, the disease spreads more rapidly in autumn and winter, because the wool is then long and thick,

furnishing favorable conditions for the parasites, and because the sheep are kept in closer contact at these seasons. The disease makes more rapid progress and is much more fatal with the weaker sheep. These parasites may be transferred from one sheep to another in a great variety of ways; for instance, tags of wool may be rubbed off and dropped almost anywhere. Diseased sheep infect posts and fences by rubbing against them, and the parasites escape from one sheep to another while the sheep are in close contact in yards and sheds. These parasites may revive and become infectious after a short exposure to severe cold weather, but are soon destroyed by alternating changes of heat and cold. They may live three to four weeks, at ordinary temperatures and under ordinary conditions, around stables and sheds. Some authorities say they do not live longer than two or three weeks apart from the sheep's body, but it is certainly wise to extend this period to three or four weeks for safety.

FOOT SCAB.

The disease caused by these parasites appears on the feet and limbs. The diseased area extends very slowly, but may eventually reach the body. This form of scab spreads very slowly from one animal to another, and is therefore much less serious than body scab. The first symptom is reddening of the skin followed by a scaly appearance, and later by light-colored scabs. The sheep having this disease are apt to be almost constantly stamping and pawing.

Local treatment.—Any of the sheep dips recommended for body scab are effective for this form of the disease. A ten per cent solution of the creolin is simple, safe and easily applied.

Any dip or ointment that will kill the parasites is sufficient early in the disease, but it may be necessary in old cases to soften the scabs by a little oil or a thorough scrubbing with brush and hot soap suds. (See treatment.)

HEAD SCAB.

The mites which cause this type of the disease burrow tunnels in the skin. The eggs are deposited in these tunnels and there hatched. This type of the disease usually shows its first symptoms around the lips or nostrils, but may appear on almost any

portion of the head. Occasionally it invades the neck and other portions of the body where the wool is short.

Local treatment.—The same as for foot scab.

GENERAL PREVENTION.

Prevention is more important than treatment in any case where it can be secured; because it is surer; it is cheaper; and is usually much easier to administer than medical treatment.

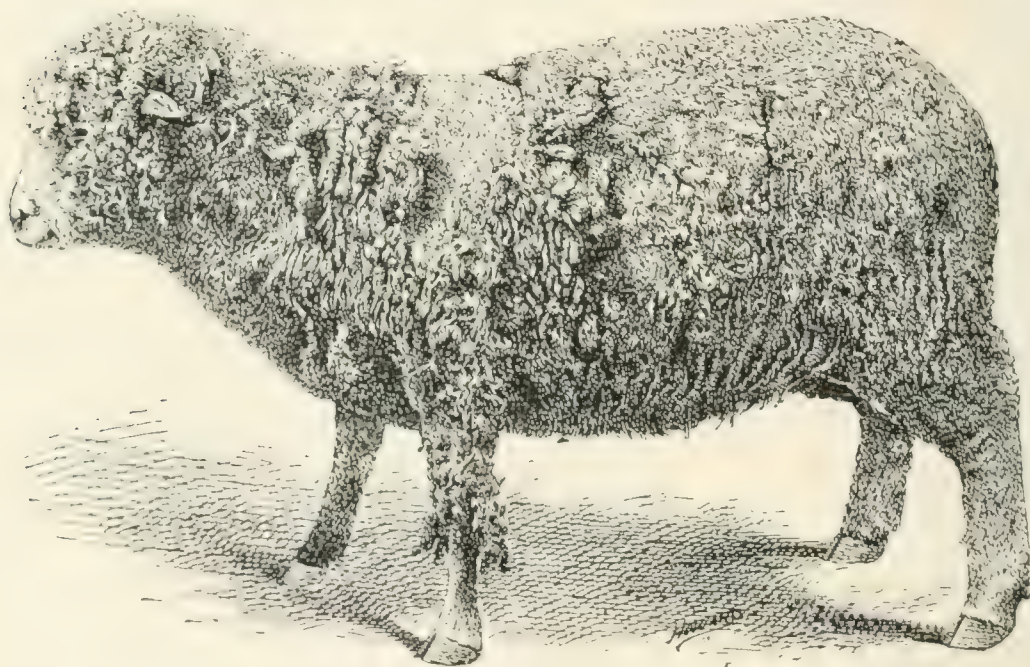


FIG. 72. A PLAIN CASE OF SHEEP SCAB.

The spread.—Whether the disease spreads rapidly over the body or not depends to some extent upon the thriftiness or unthriftiness of the individual animal. When sheep are fat and the wool is well supplied with yolk this disease spreads slowly, and is much less serious. It should be borne in mind that sheep cannot have scab unless the mites first reach the surface of the body. The infection is frequently made when one sheep rubs against posts or fences where scabby sheep have previously rubbed. In the latter case the mites are first transferred from the diseased sheep to the post, and then from the post to the healthy sheep. In other cases the mites are transferred when a diseased sheep rubs against a healthy one.

Exposure resistance. —The mites which cause foot scab and body scab have considerable vitality, being able to withstand exposure at moderate temperatures from one to two or even three weeks under favorable conditions, possibly longer. They die sooner in a dry atmosphere than moist. Cases are on record where sheep seem to have become infected with scab in places where sheep had not been kept for many months. The history of these cases, however, is not well understood, and it is difficult to say positively how long mites or their eggs may preserve vitality under favorable conditions.

Precautions. —Scabby sheep should not be driven over any public highway. Pens, sheds and yards which have held scabby sheep should be thoroughly cleaned and disinfected, and unless the disinfection is very thorough they should not be used for sheep until at least four weeks have elapsed. It is supposed that a hard rain will practically disinfect ground surfaces, but not fences and posts. Fields and pastures in which scabby sheep have been held should not be used again until after an interval of several weeks, and preferably not until after a heavy rain.

GENERAL SYMPTOMS.

History and diagnosis. —At the point of first infection there appears a small, congested area, showing plainly the result of irritation caused by the parasite, which has burrowed into the skin. Then there appears a little pimple, soft on top, which ruptures and a little fluid escapes. Dust and other foreign matter collect in this fluid and the initial scab is started.

Affected sheep are usually uneasy and are seen to scratch against posts, rub against other sheep and even bite the itching surface. The irritation is most noticeable when the sheep are heated, as by exercise, or confined in a close room. At first the wool is noticed to hang in tags, the sheep begin to pull out portions of the wool with the mouth, and the skin becomes bare in small patches which gradually increase as the mites spread, irritating and inflaming the skin. To determine the presence of the mites, scrape off some of the scab and a little of the healthy skin near the border of the scab. Place these scrapings upon some smooth black surface in warm sunshine, and examine with a good hand lens. The mites may then be seen as minute white bodies. They

are most certainly recognized when they are seen to move, and it is sometimes difficult to distinguish otherwise between the mites and particles of light colored dust and epithelial scales from the skin surface. It should be borne in mind when examining a case of head scab that the mites which cause this disease burrow beneath the surface of the skin, and it is necessary to scrape deeper than for ordinary body scab.

Varieties.—Each of these three types of mites may affect different domestic animals, including horses and cattle, but there seems to be a different variety for each domestic animal. The variety which causes scab in sheep is very similar to, but not identical, with the variety which causes mange in horses, and the one which affects horses also differs from the variety of the same species which causes mange in cattle. The variety which belongs to the horse, for instance, does not thrive and multiply upon any other animal.

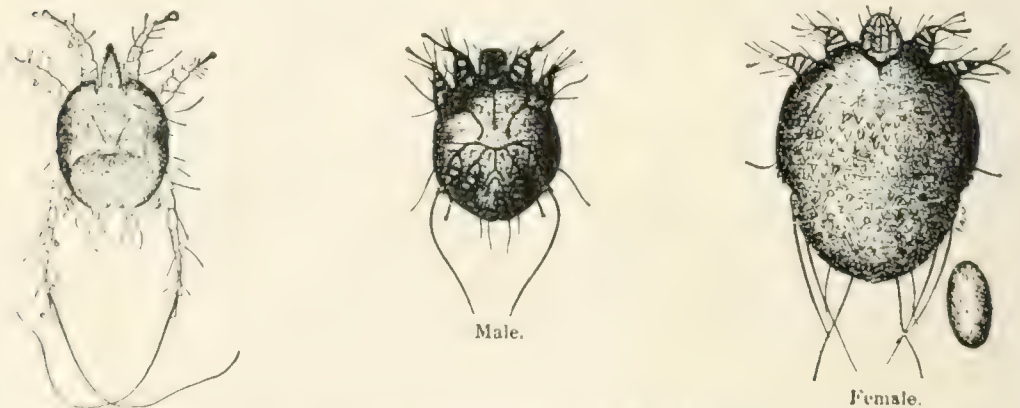


FIG. 73. SHEEP SCAB MITES.

Psoroptes, male (*Cur-tice*). Body scab.

Sarcoptes (*Luager*). Head scab.

Sarcoptes (*Pettit*). Head scab.

Possible mistakes. —It is well to bear in mind that certain other conditions may be mistaken for sheep scab, particularly disorders of the skin, produced by other external parasites; for instance, lice and sheep ticks. We have had in Minnesota an interesting outbreak of skin disease among sheep which on superficial examination resembled rather closely sheep scab, but was due to the awns of a certain wild grass (*Stipea sparta*) wild oats. It developed that these sheep had been pastured where this grass was abundant, and at a time when the awns were readily separated. These little spear-like bodies gradually worked their way through

the wool into the skin, causing inflammation of the skin and considerable irritation.

TREATMENT.

Suggestions. —Treatment is comparatively easy where there are but few sheep, but more difficult with large flocks. The size of the tank, material to be used and method of dipping must depend upon the number of sheep, accessibility and expensiveness of different materials. The dipping, as a rule, should be done after shearing, but it should be remembered that treatment for any parasitic disease of sheep should be given as early as practicable. Some good may be accomplished if the wool is parted by hand and care taken to get the medicine down to the skin, but it is the usual experience that dipping unshorn sheep is much less satisfactory. The entire flock must be dipped; that is, those that are apparently well as well as those that are diseased. And the owner must bear in mind that, even after shearing, the wool may be a source of danger, and should be so kept and handled as to avoid the possibility of reinfection. Dipping is effective only when it is thoroughly done. Tobacco, crude carbolic acid, arsenic, lime and sulphur are the various ingredients that are commonly used in dipping for scab. The quantity of dip required per sheep varies from two to four gallons, according to the number of sheep dipped and the material used. Less dip is needed for shorn than unshorn sheep. It is a good rule to use any dip at about 110 degrees Fahrenheit, and a good plan to rub the scabs with a stiff brush while the sheep are in the dip. Dipping should be repeated in eight days, and in some cases it may be necessary to give even a third dipping after a second interval of eight to ten days.

Dips. —A great variety of dips have been recommended and successfully used. Several of the patent dips give excellent results, but these are usually more expensive than others and are objectionable, inasmuch as we do not know their composition. The following are perhaps as good as any.

Texas dip. —What is known as the Texas dip is composed as follows: Thirty pounds tobacco, seven pounds sulphur, three pounds concentrated lye, 100 gallons water. Allow the tobacco to soak in a portion of the water, which should be kept warm, for from eight to ten hours; then add the sulphur, remainder of the water and concentrated lye, and boil for half an hour. Stir frequently while using.

Zundlé's.—The following is a formula for a modification of Zundlé's dip. (Modifications suggested by Dr. Kaiser.) For one hundred sheep take the following: Tobacco, thirteen and one-half pounds. Soak for several hours in sixty-six gallons of water, then dissolve in this eight pounds of carbonate of soda, and four pounds freshly burned and slacked lime; then take eight pounds of soft soap and dilute with some of the hot tobacco infusion and add to the materials previously mixed; then add four pounds crude carbolic acid; mix thoroughly. Use hot.

Dipping.—The entire flock should be first shorn, then dipped and confined for eight to ten days in a field or pasture where there had been no scabby sheep for at least two months, and then re-dipped and placed in another field or pasture in which there had been no sheep for at least two months. Each sheep should be kept in the dip at least two minutes by the watch, and each sheep to go under entirely at least once. Heavily pregnant ewes can be safely dipped if handled with care. In using any dip, no matter if proprietary or home made, follow directions exactly. It is not uncommon for stock men to have unsatisfactory results from the use of well recognized dips, and it is usually because they try using the dip a little weaker than the directions call for, or because they were a little careless and hurried the sheep through the dipping vat too rapidly, or by returning the sheep after dipping to infected pastures or yards.

A SMALL DIPPING VAT.

A vat of some kind should be owned by every farmer who keeps many sheep, calves or hogs. It can be used for dipping any of these smaller animals for any of the external parasites, and this is a rapid and effective way of treating such parasites.

The description of this little vat and of the method of using it were suggested to the writer by Mr. J. E. Story, for many years superintendent of the famous Bow Park stock farm in Canada, and a very thorough stockman.

The vat should be made of best pine lumber, one and one-quarter inches thick and should be six feet long at the top and four and a half feet at the bottom, two feet wide and two feet six inches deep. One end is square and the other sloping according to the above dimensions. Slats are nailed across the sloping end to

assist the sheep in climbing up to the dripping rack, which stands at the sloping end. The vat may be sunk in the ground from six to ten inches to save lifting. Each end of this vat should be supported by two small rods across the tank about four inches from the top and six inches from the bottom.

The dripping rack should be at least three feet wide and from twelve to twenty feet long. The bottom must be water-tight, and there should be a narrow slat along each side, well nailed down, to keep the drip from running off at the side before it reaches the vat. Cleats should be nailed on the bottom, as shown in the figure, open at the center and sloping slightly toward the vat. One end of the dripping rack rests on the sloping end of the vat and the other is supported by two legs, which should be enough higher than the other end to cause a free flow back into the vat. The dripping rack should have hurdles at the sides high enough to keep sheep from jumping off, and there should also be a gate at the farther end, which may be opened from time to time to let sheep off the rack. There should also be placed at the farther end of the rack a couple of planks with cleats so that sheep may walk down from the rack when they are done dripping.

A tight wagon box with side boards, and tilted so as to drain into the vat, makes an excellent dripping rack for a small flock.

A small V-shaped pen should be made of hurdles at the square end of the vat and the sheep may then be crowded closely toward the vat by means of a movable gate or hurdle at the wide end. Two men, one on each side at the square end of the vat, can easily lift the sheep, one by one, out of the pen into the vat and then assist them to climb up to the dripping rack, where they stand and drip while others are being dipped. When the rack is full, the gate is opened and a few of those in front are let out.

LECTURE XLVIII.

NODULE DISEASE OF SHEEP.

General history.—The history of outbreaks is often as follows: Sheep have access during the summer and fall to pond or well water that receives drainage from a sheep yard or pasture. Perhaps the grass was short and the flock was compelled to graze very close.

During the winter the flock becomes unthrifty; some individuals grow gradually thinner and weaker until a number die during the late winter and early spring. As soon as the grass comes and the sheep are turned out they begin to do better and the disease seems to disappear. A dead sheep is opened and the intestines show a large number of nodules, about the size of garden peas.

Cause.—The disease is caused by a minute round worm (*Oesophagostoma columbianum*). The adult worms are about half an inch in length and may be found in the intestines. The immature forms vary from 1-100 to 1-6 of an inch in length, depending on the age and stage of development, and are found inside of the little nodules which constitute the most prominent feature of the disease seen on examination post mortem.

The eggs are laid by the adult female in the intestine. The eggs soon hatch, and the embryo worms pass through the internal lining of the intestine, and become imbedded, giving rise as foreign bodies to the little tumors or nodules which nature throws around them, evidently in an attempt to fence them off. They cause some irritation as foreign bodies, and this irritation will account for the little tumors which are found on the side of the intestine.

Some of the adult worms pass out with the manure, and thus infect the pastures and feed yards, ponds or sluggish streams which receive their drainage.

Injury done.—The extent of injury to the individual sheep depends mainly upon the number of worms present, and the con-

dition of the sheep as to vitality and resisting power. There may be something of an inflammation of the bowels while the young worms are passing through the lining of the intestine, but the main injury is that of starvation. So large a portion of the bowel is diseased by the parasites when they are present in great number that there is not enough healthy tissue to absorb the food material. A badly infested sheep may have plenty of good food and yet be too weak to eat it or if able to eat, he may still be starving because the intestinal wall can not take up the food that may be ready for absorption.



FIG. 74. NODULE DISEASE. (M. H. R.)
Intestines of sheep.

Older sheep suffer worse, as a rule, because the longer an infected animal lives the worse the intestines become diseased by the parasites.

Diagnosis.—This can only be made by finding the characteristic nodules in an examination of the dead animal, for sheep infested with some other parasitic diseases, show similar symptoms and conditions during life.

Treatment.—It is probable that but little can be accomplished by medical treatment, because the worms, during a large part of

their life history, are walled up in these nodules and beyond the reach of any medical agent.

It is possible that worm-destroying medicines, frequently repeated during the summer, might prove both curative and preventive, by killing the adult worms, which live free in the intestine. In dealing with a serious outbreak of this disease it should be remembered that infested flocks usually do fairly well during the summer and early fall months. If a flock is badly infested with nodule disease it will generally prove good management to nurse the flock through until spring, then depend on getting the sheep into shape for market during the summer and sell out for butcher stock in the early fall. Such sheep are entirely fit for food purposes when in good flesh.

Prevention.—New sheep should be purchased from a flock that has been thrifty during two previous late winters and early springs, and they should be kept for two seasons on some other pasture than the one previously used on the infected farm. It will be better still if the flock can be kept part of the season on pasture and part of the seasons on plowed crops, e. g., rape, sorghum, field peas, or meadow land that has not recently been used for sheep pasture. The new flock must not be allowed to drink from any pond or sluggish stream that has received drainage from the infested pasture or barn yard.

With a view to preventing this and other parasitic diseases, the flock should not be kept too long on one pasture, but should be moved from pasture to pasture; and from pasture to stubble fields, cut-over meadow, rape, etc. Sluggish streams and ponds should be regarded with suspicion always.

It is possible to practically rid a flock from this disease by following this course of shifting the flock about for several years, plowing up pastures occasionally and using plowed crops, but in most cases, with the exception of valuable sheep, particularly breeding flocks, it will usually be found more satisfactory to change the entire flock on the plan suggested.

LECTURE XLIX.

STOMACH WORM (Sheep).

One of the especially common and serious parasitic diseases of sheep, and this means much, for the parasitic diseases of sheep are the serious ones. This disease is very widespread and almost universal.

The parasite (*Strongylus contortus*) which causes this trouble is a small threadlike worm, perhaps an inch in length and so slender that they must be looked for carefully or one is liable to miss them. The individual worms are somewhat twisted and are found in the fourth stomach. Frequently they are in motion. If they are present in great numbers as is frequently the case, the portion of the stomach contents next to the mucous membrane may seem to be fairly alive. The worms vary in color from dirty white to reddish.

Life history. —This is a permanent parasite, being present in the stomach at all times of the year. The eggs pass out with the feces and are afterwards taken in by other animals with the water or food, particularly when in pasture.

Symptoms. —There are no diagnostic symptoms by which this disease can be distinguished from other internal parasitic diseases of sheep. There is a gradually developing weakness and unthrift. Lambs are affected more seriously than older sheep. These are unthrifty during the late summer, and some die during the late summer and fall.

Treatment —The Bureau of Animal Industry has done some careful experimenting in this line, and recommends *coal tar creosote* as the most satisfactory treatment for this parasite. This medicine is not expensive and is very easily obtained and prepared. It is important to insist upon getting coal tar creosote, not beach wood creosote which is ordinarily dispensed, the coal tar creosote being cheaper and more satisfactory. It is given as a one per cent solution; that is, one ounce of the creosote to 99 ounces of water, in doses proportioned to the age and size of the

sheep. Lambs four months old take two to four ounces. Older sheep take three to five ounces. If there is any reason to suspect the presence of worms in the intestines, then thymol should be added to the creosote treatment. The dose of thymol is from 30 to 100 grains. Each dose of thymol is to be added to the dose of creosote after the latter has been mixed, measured and should then be given immediately. Only the fresh crystalized thymol should be accepted. The affected animals should be kept from feed for 16 to 20 hours before medicinal treatment is given.

Bluestone (copper sulphate) has been commonly accepted as one of the most satisfactory treatments for this trouble, but it needs to be given in carefully regulated doses. This medicine may be made up as follows: Dissolve one pound (avoirdupois) of fresh powdered bluestone in nine gallons of water. For this treatment the animal must be kept off feed from 20 to 24 hours. The dose for a lamb six months old is 40 c. c.; sheep 12 months old, 60 c. c. (about two ounces); 18 months, 80 c. c.; two years, 90 c. c.

Drenching sheep.—For giving medicine to sheep a drenching tube should be used or a large piston syringe, or a long necked bottle. A very satisfactory drenching tube may be easily made with an ordinary tin funnel which is inserted into one end of the rubber hose about three feet long and about one-half inch in diameter. A piece of brass or iron tubing four to six inches long is inserted into the other end of the tube. The metal tube is placed in the animal's mouth between the back teeth, the funnel end is held at a convenient height and medicine poured slowly into the funnel. In administering medicine for treating the stomach worms, it is better to give the medicine with the sheep standing on its feet, because actual experiment has demonstrated that while the animal is in this position, more of the medicine goes directly to the fourth stomach where it is needed.

Prevention.—Sick animals must be removed from the flock and put in a pasture or yard from which there is no drainage to the pasture or yard used by the flock. Water must be taken from good wells that do not receive surface drainage. The tank or trough should be high enough above the ground level so that the water cannot possibly be contaminated from droppings. High and well drained pasture is always safer than low pastures, unless

the latter are well drained. Infected pastures should be burned over thoroughly and regularly for the purpose of destroying eggs and young worms. It should be borne in mind that when animals are well fed and well nourished, they are better able to resist the invasion of any parasite.

LECTURE L.

FOOT ROT OF SHEEP.

This is a very old and familiar disease. It is especially prevalent on soft, wet pastures, but sometimes prevails under conditions of extreme drought. Some outbreaks are infectious. There are other cases which appear similar upon hasty examination, but are evidently not infectious.



FIG. 75. FOOT ROT OF SHEEP.
A plain case.

General symptoms.—This disease usually affects the four feet and produces lameness, perhaps one fore foot at first, between and above the claws. There is a discharge, with very offensive odor, and the hoof itself becomes rotten in places. Loose pieces are detached and the sole may be affected the same way. The sensitive parts may be exposed in very severe cases, with a development of profuse granulations. The skin above and between the hoofs is red, tender and swollen. The animal is lame and of course unthrifty. The disease prevails more especially in late summer.

Differential diagnosis.—It is necessary to distinguish between infectious foot rot and a quite different disease which we know as "foot and mouth disease." Foot rot begins in the skin between the claws, and perhaps soon involves the sole. It then spreads

both as to surface and depth, involving the deeper structures of the foot. Foot and mouth disease begins in an inflammation of the skin just above the hoofs. This becomes red, then small vesicles develop which rupture and then dry. Foot rot is a disease especially of horn tissue. In foot and mouth disease the whole hoof may loosen at the crown, the inflammation involving especially the skin at the crown and the sensitive parts under the wall and above the sole. In foot rot the horn is diseased and separates in pieces. Foot and mouth disease affects several feet and perhaps the mouth also—simultaneously. Foot rot usually affects one foot at first and there is little or no fever in common cases, whereas, in foot and mouth disease the fever is characteristic.

Simple foot rot.—*Causes:* This is a disease of the horny parts, often due to overgrowth or injury, either one of which may result in a laminitis, and so result seriously for the foot. Similar conditions may account for the development of a considerable number of cases, but this disease does not spread from one animal to another as does the infectious type. Some cases are apparently due to the chaffing action of rough, wet and coarse grasses between the claws. This may be very serious in a few cases, but is not a disease of general importance. Moisture seems to bear an important relation to the development of this type of the disease.

Treatment.—Clean thoroughly between the toes; pare away all diseased horn and remove the loosened pieces. The hoof, if grown out of shape, must be trimmed to normal proportion. Excessive granulations must be cut away or removed by actual cautery, and be repressed by astringent measures or pressure bandages. Pledgets of tow may be dipped in tar and applied over the granulations so as to bring pressure at the right point. These patients should be kept upon clean, dry footing, and serious cases should be taken up and kept in the yard or in dry stable. For astringent dressing we may use tincture of iron, varying from full strength to one to four, dissolved in water. Four per cent carbolized tar makes a nice application for cleansing and disinfecting, and keeps out dirt. The medical treatment, particularly the astringent, should be very carefully applied, especially into the crevices and deeper recesses.

Treating whole flock.—It is frequently advisable to treat a whole flock in a general way; in that case the flock may be driven through a large pan containing a solution of copper sulphate about

four inches deep; the animals should be forced to remain in the pan for several minutes, so as to insure good treatment. This solution should be made up dissolved in water in the proportion of one to two pounds per gallon of water.

Prevention. —Separate diseased animals from the healthy ones, and bear in mind that either very wet or very dry pastures may be favorable to the development of this disease. Hoofs should be kept pared to reasonable proportions. Cases of foot rot should not be neglected in the earlier and simpler stages, for they are much easier treated then. They may be infectious and careful treatment and attention may avoid a general outbreak.

LECTURE LI.

VERMINOUS BRONCHITIS, NASAL GRUB, AND CATARRH.

VERMINOUS BRONCHITIS.

Definition.—A disease of the bronchial tubes and lungs, caused by minute round worms. The worms are similar in different domestic animals, but each animal has its own species. There is therefore little danger of infection from one kind of domestic animals to another.

Life history of the parasite. —Young sheep, young goats, cattle under two years of age, and young pigs are susceptible to this disease. The mature worms are found in the bronchial tubes as well as eggs and embryos. These may be coughed out and ultimately reach pools or small ponds of stagnant water. The larvae are usually swallowed with the food or drink and some of them ultimately reach the trachea probably by way of the larynx. It is possible that the eggs may be inhaled directly with particles of dust. Infection occurs mainly in the spring. The parasitism remains long dormant, slowly developing until fall. The disease seems to be especially common in wet years. Embryos and eggs are very resistant and the parasite is very tenacious of life at all stages.

Symptoms. —At first there is a bronchial catarrh; later a chronic anaemia, with progressive loss of flesh, and strength. There is a cough which at first is rather harsh, and later very weak. The cough is worse when animals are excited and when they move around. Sometimes small balls composed mainly of worms may be coughed out and actually seen. Respiration is difficult and in some cases wheezing. Calves are able to resist rather longer than sheep.

On examination post mortem there may be found masses of minute thread-like worms in the trachea and bronchial tubes, with considerable quantity of purulent and viscid liquid in the

tubes. Some lobules of the lungs may show very marked pneumonia. There may also be tubercles resembling those of tuberculosis, near the surface of the lungs, and also throughout the lung substance.

Treatment.—For the present we must consider this as generally unsatisfactory. Treatment by injection of medicines directly into the trachea has been tried and recommended in some cases, but is very apt to prove unsatisfactory. In cases of valuable sheep the following is worth trial:

Olive oil, 100 grams.

Turpentine, 100 grams.

Carbolic acid, 2 grams.

Give ten grams per day for three days. Each dose is given by a large hypodermic syringe and injected directly through the side, into the trachea.

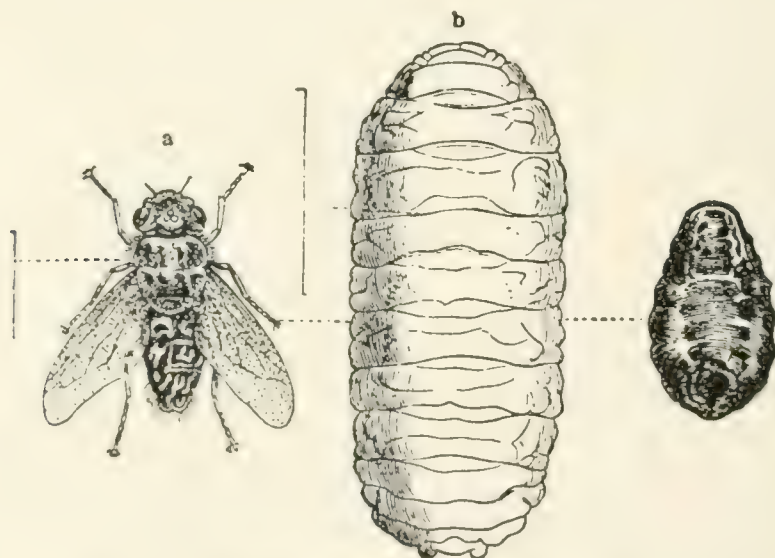


FIG. 76. SHEEP GAD FLY (*Oestrus ovis*).
Commonly called "grub." a, Adult; b, Larva; c, Puparium.

Prevention.—Change pastures often; keep sheep upon forage crops and upon frequently changed pastures. Avoid ponds and well water which receives drainage from pastures, feed lots or barn yards.

NASAL GRUB (GRUB IN THE HEAD).

This is a very poor name for a disease, but is the only one commonly understood and is used here for that reason.

Cause.—This disease is caused by a parasite which inhabits the various cavities of the head which communicate with the nasal chambers.

Life history.—The mature fly resembles the well known bot fly of the horse; is of a dirty yellow or grayish yellow color, and appears in the middle of the day from July to September. The young larvae are deposited about the nostrils of the sheep, from whence they crawl up into the various cavities of the head, including the horn cores, and may even reach the brain substance. They mature in about nine months. The developed grubs work out, escaping from the nose during the spring, from March to May. They then pass through another stage before the adult fly appears, which occurs in six or seven weeks from the time the grubs escape from the nose.

Symptoms.—A nasal discharge appears during the spring. The sheep sneeze, shake their heads, and rub their noses and faces against their feet or other objects; sometimes there are attacks of vertigo and the walk may be unsteady or irregular; severe cases develop convulsions and die. On examination post mortem, grubs are found in the various openings and chambers of the head and the mucous membrane lining these cavities is inflamed.

Treatment.—Medical treatment under ordinary circumstances is not practical, and prevention is very difficult to apply on a large scale. Before the sheep are turned out in the morning their noses may be smeared with tar or a mixture of tar, turpentine and fish oil. They may be forced to take their salt out of a large hole bored in a log or a plank, the tar being smeared around the edges of the hole so that when the sheep take their salt they get a little tar around the nose and mouth.

CATARRH IN SHEEP.

Cause.—Simple catarrh in sheep is usually due to cold rains, imperfect ventilation and damp quarters, or undue exposure after early shearing. In other words, simply a case of catching cold. Many cases of catarrh are due to parasitic invasion of the nasal chambers and head sinuses. However, these latter are not included under simple catarrh. This disease is not contagious, although many cases may appear simultaneously, due to common causes.

Symptoms.—The affected sheep are noticed to be sneezing, with discharge from the nose and eyes, and sometimes coughing.

The nasal discharge is thin at first, gradually becoming thicker. Some cases become chronic, and especially when the subjects are weak and unthrifty. The inflammation of the nasal mucous membrane may then extend into the head sinuses, and cause extensive collections of pus, and also extend down the mucous membrane lining the trachea.

Prevention.—First of all, abundant ventilation at all seasons. Sheep are very frequently housed too closely in winter. The interior of the building becomes very damp and the conditions in general are unwholesome. Healthy sheep do not need much protection in the winter time, so far as warmth is concerned. If they are well protected from cold rains and snows, and from cold winds they are most thrifty with abundant ventilation. Sheep that are shorn early in the spring need careful management for a time in order to prevent their catching cold.

Treatment.—The sick animals must have shelter. Their quarters must be dry, reasonably warm, and well ventilated. They must be well fed. The medicinal treatment should consist mainly of tonics, for instance: a simple, bitter vegetable tonic, like gentian root, which may be given in a powdered form in the feed two or three times daily; about one dram per sheep.

LECTURE LII.

HOG CHOLERA, AND SWINE PLAGUE.

Definition.—It is evident that there are at least three distinct diseases of swine which are commonly confused under the name of hog cholera. These are true hog cholera, swine plague, and swill-barrel cholera. Most of the outbreaks of infectious disease, under this name are mixed infections of hog cholera and swine plague.

Very few typical cases of either swine plague or hog cholera alone are seen.

It is undoubtedly possible to have an unmixed outbreak of either hog cholera or swine plague, although the existence of epidemics of swine plague unmixed with hog cholera has not been clearly proven. Unmixed infection from hog cholera in which no swine plague lesions appear is probably more common. It is a matter of some importance for farmers and stockmen to know which disease they have to deal with, or whether there is mixed infection, for while these diseases are equally contagious, and equally fatal, the swine plague germs are much more easily destroyed, and this disease is much more easily controlled than is hog cholera.

Variations in virulence.—Different outbreaks of so-called hog cholera vary greatly in virulence. In some epidemics the infection is marked, and the hogs die quickly; in other epidemics the majority of the cases assume the chronic type; the hogs do not die so quickly, and the percentage of loss is not so great.

Various gradations may appear between epidemics of the utmost virulence and those of the milder type.

Two factors are to be considered in explaining this variation. It has been shown that there are at least six varieties of the hog cholera bacillus which differ somewhat in the virulence of the disease they produce, and that each one of these varieties, under uniform conditions, will produce a certain type of hog cholera.

The other factor to be considered in explaining this variation is in the differing conditions of food and care under which hogs are kept in different yards and different localities. Where the feeding and care has been such as to secure the best physical strength and vitality, the hogs are naturally less susceptible. the disease does not assume the most virulent type, and the percentage of mortality may not be so high as among hogs kept under less favorable conditions.

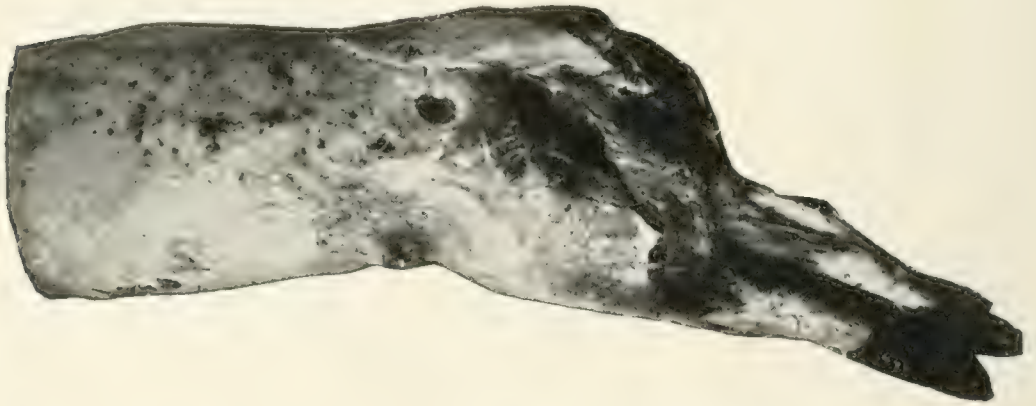


FIG. 77. HOG CHOLERA—SWINE PLAGUE. (M. H. R.)

Subcutaneous haemorrhages of swine plague, resembling those of haemorrhagic septicaemia in cattle. Note the dark spots.

Swill-barrel cholera.—The fact must not be lost sight of, in this connection, that frequent outbreaks of swine disease appear and alarm neighborhoods when the trouble is due to local causes. They are usually diseases of the digestive apparatus and due to errors in feeding. All the patients become diseased from the same source and in the same way but the disease does not spread. Several neighbors may make the same mistake at the same time and get similarly bad results. These are the cases which are called hog cholera and which yield to treatment.

Early symptoms.—When these diseases appear the hair becomes harsh and dry, the eyes may be watery, and locomotion becomes weak and irregular, with imperfect control of the hind legs. The skin around the flanks and fore legs may become purple; the skin of the ears frequently becomes much inflamed, and if the hog lives for several days, may assume a scabby appearance. Sometimes the tips of the ears slough off. The sick hogs separate themselves from the rest of the herd, are disposed to hide in sheltered places, and seem but little inclined to move about. There

is usually a loss of appetite, although in some very acute cases the appetite may remain good until the end. The chronic cases lose flesh rapidly, and sometimes show extreme disturbance of the nervous system, exhibited in partial or complete paralysis of the hind parts, or extreme nervousness. Cough is usually short and hacking. Occasionally constipation appears among the earliest symptoms, but is usually not noticed by the owners; later, diarrhea appears. In some of the very acute cases which appear at the beginning of an outbreak the animals die very suddenly; sometimes before the owner realizes that they are sick. Later in the history of the disease, as it appears in a herd, the cases tend to assume a more chronic type.

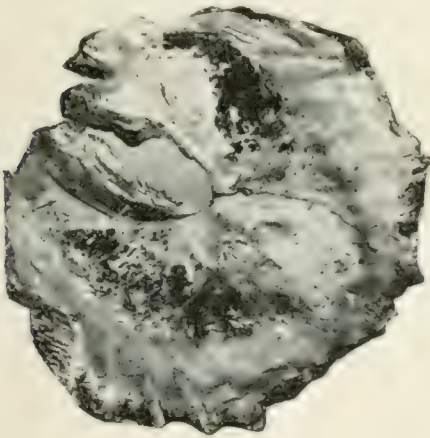


FIG. 78. HOG CHOLERA—SWINE PLAGUE. (M. H. R.)

Haemorrhages (dark spots) on diaphragm. Haemorrhages are characteristic of swine plague.

If the swine plague infection is marked, the coughing and shortness of breath are the most prominent symptoms. If the case is more nearly typical hog cholera, the bowel symptoms are more prominent.

Sometimes quite large portions of skin and underlying muscular tissue die and slough off, leaving large sores. This appears more commonly, perhaps, around the neck, head, and back than elsewhere.

Hog cholera post mortem.—In hog cholera the skin on exposed parts of the body where the hair is thin, like the flanks and inside of the fore legs and thighs, may be deep red or purple. Blood-stained spots may be usually found in the fatty tissue under the skin and on the internal organs. The lungs may show evidences of pneumonia. The lymphatic glands in the mesentery appear deeply congested.

When the large intestine is split open, dark spots, more or less blood-stained, or even clots of blood, are to be seen upon the lining membrane when the disease has been of the very acute type. The more chronic cases show peculiar and very characteristic ulcers in the lining membrane of the large intestines, and

they are usually more numerous near the blind pouch. These ulcers are irregular in outline, with yellowish or dark centers, and frequently appear as being raised above the surface. Small ulcers may also be seen in the back part of the mouth and in the throat.

The spleen is frequently enlarged, and darker in color than natural. Small bright red spots are found on the surface or through the deeper structure of the kidneys.

Swine plague post mortem.—In swine plague the lung lesions are most prominent. The skin may show the same purple spots and areas as in hog cholera. The lungs show scattered and sharply defined areas, which are dark red in color, and solid, like liver. The lining membrane of the chest may be diseased; but it is not uniformly so, and when this occurs, it usually follows disease of the lung tissue. The bowels may show various stages and conditions of congestion, hemorrhage and inflammation, but not the typical "button-ulcers" of hog cholera. Hog cholera is essentially an infectious disease of the bowels.

The cause. —We must not forget that swine plague and hog cholera are both infectious diseases, and that each has its prime origin in a specific germ. Simple conditions of keep and feed have much to do with making the animals more susceptible, but mere matters of food and surroundings cannot serve as first cause of either hog cholera or swine plague. The predisposing factors in the causation of these diseases must be given due consideration, but the most important thing to remember is that both are due to specific germs, that they never appear without infection, and that they may be carried from one place to another. If the hog is fed exclusively on corn diet, or from a swill barrel that has been used for years and never scalded or allowed to dry in the sun; if it is kept shut up in dark, damp, and perhaps filthy pens, it will not be able to resist any disease as would one kept under more favorable conditions.

It is evident to all who have given the subject careful attention that swine hygiene should receive far more attention in the future than it has had in the past, and that here there is a large field for scientific study. Good lungs and good digestion must be regarded as the pig's chief protection against disease. Good digestion aids in the destruction of bacteria in the food, while congestion or catarrhal inflammation of the mucous membrane of stomach may result in a smaller percentage of acid in the gastric

juice, and thus the germ-destroying power of this fluid would be diminished. Tissue vitality in the lungs must be regarded as a very important factor in increasing the disease-resisting power of the animal. The laws of hygiene cannot be neglected without rendering animals more susceptible to disease.

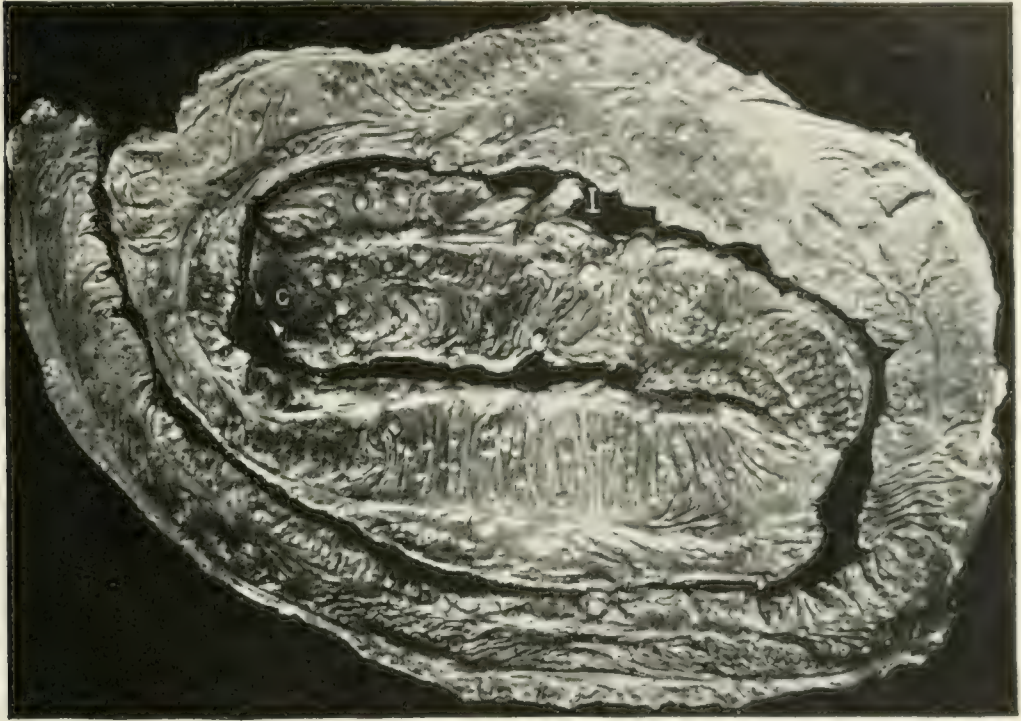


FIG. 79. HOG CHOLERA. (M. H. R.)

Large intestine, mucous membrane showing general distribution of typical ulcers. I, Ileum; C, caecum or blind pouch.

How scattered.—The germs of these diseases may be carried from place to place upon shoes, or by wagons, or by driving stock back and forth over an infected area; or they may be scattered by driving or transporting infected hogs along the public highways. Dogs are common carriers of this disease. Running streams and shallow lakes are also serious factors in the spread of these disease germs. Bowel discharges are very important sources of infection, and if the yards or pens drain into streams or lakes, these become carriers of the infection. Hogs that have died of hog cholera are sometimes thrown into streams or buried in the sand near the edge of a stream or lake, thus infecting the water.

Practical differences.—Hog cholera germs may live three months, and possibly longer under favorable conditions. They are hardy and difficult to destroy. Swine plague germs live but a short time, perhaps two or three weeks under favorable con-

ditions. Thus it will be seen that an outbreak of hog cholera, or of mixed infection, is more difficult to control and more serious in every way than is an outbreak of swine plague, because the germs will linger for a longer time in the soil and various hiding places. These two diseases spread with equal rapidity, are disseminated by the same conditions and in the same way, and so far as known, are equally fatal.

When an outbreak appears.—In case there is a suspicious disease among hogs in a neighborhood, the matter should be reported promptly to health officers, and this first outbreak should be rigidly quarantined.

But one man should have the care of a herd of healthy hogs, and this man should not be allowed to go where there is a possibility of getting the infection. Neither the owner nor any member of his family should go to any farm where an infectious swine disease has appeared; nor should anyone from the farm where such sickness is present be allowed to walk about the yards of his neighbors.

Dogs and other dangerous visitors should be kept away from the pens on uninfected farms by a temporary fence of woven wire.

Before a herd becomes infected, it may be very desirable to divide it into three or four parts, and separate these groups widely on different portions of the farm. The owner may then lose one group, or even two groups, and still save the others, should the disease come his way.

If hog cholera appears in a herd during the summer or fall when the weather is pleasant, it is desirable to turn the hogs out into a large yard or field rather than to keep them closely confined in pens or stables, where the danger from infection is greatly increased. Larger or smaller doses of infection have much to do with determining the fatality of the disease. If hogs are allowed to run in yards or fields, each hog is exposed to the smallest possible amount of infection. With a herd so treated, the disease may reasonably be expected to spread less rapidly, and to be somewhat less fatal. Hogs should not be allowed access to small ponds or mud holes during the prevalence of any suspicious disease among them. Such ponds and mud holes become deadly centers of infection.

If the weather is cool or wet, the herd should be given quarters as warm and dry as possible, for with hogs turned out to shift

for themselves, under such conditions of exposure, the mortality is apt to be very high.

It is apparently useless to spend money on medicines in the treatment of either of these diseases. Before giving credit to patent medicines, one should bear in mind that outbreaks often check suddenly without any treatment.

Experience demonstrates that it is desirable to separate the well from the sick animals promptly, and to place the well in uninfected sheds, pens or yards. It is also desirable to keep both the pens where the sick and the healthy hogs are confined, thoroughly cleaned and disinfected. For this purpose, unslaked lime is quite satisfactory, and it is easily applied.

The manure should be kept in compact piles outside of the pens, and disinfected layer by layer with lime, or corrosive sublimate dissolved in water, in the proportion of 7.5 grains to the pint. Lime should also be scattered freely over the floor of the pens.

Common mistakes.—It is a mistake to *bury* hogs that have died of hog cholera or swine plague when the carcasses can be burned, for burning is by far the most efficient means of destroying the germs of these diseases. If it is not convenient to burn the carcasses, they should be buried under at least four feet of earth.

It is a mistake, and frequently a serious one, for a farmer to ship in a lot of strange hogs from unknown stockyards, in cars that may have been infected, to his own farm, and to put these with stock hogs already on hand. The mere fact that the hogs came from an uninfected district is no argument to the contrary, for the car in which they were shipped may have recently carried a lot of hog cholera victims. Strange hogs should be quarantined for three weeks before putting them with hogs already on the place. This gives time for the disease to appear in case the new hogs have come from infected herds, or through infected stockyards, or in infected cars.

It is a mistake to visit your neighbor's hog pens, and walk about among the hogs out of mere curiosity, when your neighbor has told you that some peculiar sickness has appeared in his herd.

It is a mistake to allow the last one or two sick hogs, which usually show a very chronic type of the disease, to linger for

months on the farm. It is a better policy to kill such hogs promptly, and have done with the disease. They do not usually become thrifty and profitable feeders for a long time after recovery. On the other hand, they may remain infectious to the last period of their sickness, thus keeping the yards and pens infected and furnishing a constant supply of infectious material for fresh outbreaks; whereas, if they had been killed, the infectious material could soon have been destroyed.

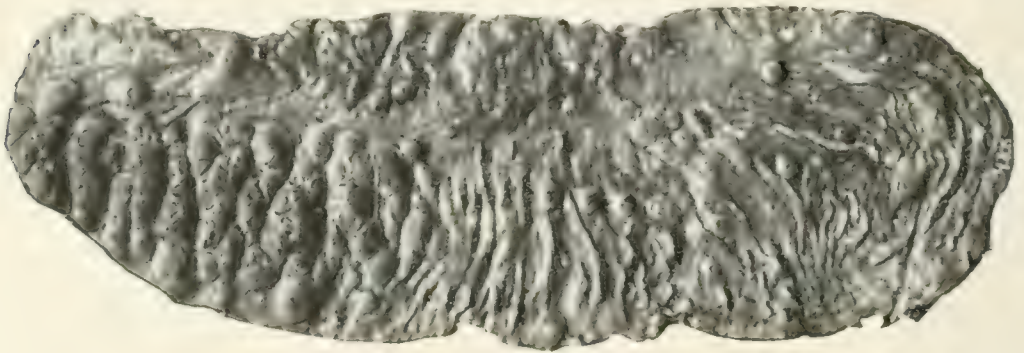


FIG. 80. HOG CHOLERA. (M. H. R.)

Ulcers in mucous membrane of large colon. Bowel split open. View of the interior.

It is a criminal mistake to throw carcasses into any stream, lake, or pond, or to bury them near such body of water.

Suggestion.—In dealing with infectious diseases of swine, there are practically but two things to be done, viz., *quarantine and disinfect*. It is a very simple matter to quarantine an outbreak of hog cholera when it first appears, and it is extremely difficult to quarantine the disease after it has been scattered over several townships. Quarantine must be rigid to be useful. Partial or imperfect quarantine is worse than useless.

Disinfection.—If the disease is swine plague, nature will disinfect in two or three weeks. If the disease be genuine hog cholera, it is not easily controlled, for the germs may live three and perhaps four months, under favorable conditions, in the soil and about the buildings. Sometimes the cheapest way to disinfect is to burn the old sheds and pens where the hogs have been confined. But if these structures are valuable, the matter of other means of disinfection is to be considered. In this case, corrosive sublimate, dissolved in water in the proportion of 7.5 grains to each pint is a good disinfectant; or whitewash that is made by using water

that contains four per cent of pure carbolic acid, may be used instead of the corrosive sublimate solution. All bedding and loose stuff should be burned. The ground may be disinfected by saturating the surface with corrosive sublimate solution, or by burning off straw that has been scattered over the surface, or the danger from infection may be lessened by plowing the infected area. Sometimes it is more desirable to destroy the floors of pens than to attempt to disinfect them, but if it is thought desirable to disinfect, they should be thoroughly saturated with the 1:1000 corrosive sublimate solution, or boiling water.

LECTURE LIIL.

COMMON DISEASES OF SWINE.

RHEUMATISM.

This disease is rather common in swine and affects either the muscles or joints.

Cause.—Frequently due to cold damp quarters, and yet cases of rheumatism appear under the most favorable conditions. It is not thought best to discuss the physiological chemistry involved, in view of the uncertainty which still exists.

Symptoms.—Affected animals are lame and sore. The exact symptoms depend of course upon the location. Very frequently the ankle joints are swollen and very tender. There is a rise of temperature in the acute cases. Food is refused and movements are very painful. This disease in swine, as in other animals, exhibits a tendency to move about from one limb or from one joint to another.

Treatment.—Physic freely; two ounces Epsom salts or two ounces castor oil, or two compound cathartic pills, then 15 drops oil of Gaultheria in one-half ounce of bland oil, like linseed oil or sweet oil, together with potassium iodide in ten grain doses three times a day, given either in water or feed. For local stimulant over the joints, apply the following liniment: 8 oz. tincture belladonna; 1 oz. tincture opium; and 1 oz. fluid extract aconite. This treatment should be applied freely on flannel cloths rung out of hot water dry as possible. For swollen joints that are not especially painful a blister gives more satisfactory results.

POSTERIOR PARALYSIS.

This is a rather common and serious disease affecting especially older swine and involving the hind quarters. In most cases it is probably a disorder of either the spinal cord or the spinal nerves. The exact pathology has not been demonstrated.

Causes.—The direct cause of those cases which depend upon organic diseases of the cord or spinal nerves is not known. A more common type develops suddenly in old and heavy swine, particularly those in high flesh and is due to simple constipation.

Symptoms.—Some cases develop suddenly; others develop gradually during several days and even weeks. There is inability to use the hind limbs which are limp and weak, not unlike affected limbs of horses having azoturia. Hogs affected with this disease usually retain good appetite and are lively aside from the posterior paralysis. They are apparently in good health for weeks, having perfect control of the front limbs. If they move at all the hind limbs are simply dragged. This trouble is easily distinguished from rheumatism in most cases by absence of pain.

Treatment.—A decided physic, 10 to 20 grains of calomel in a small piece of pork; or 2 oz. castor oil with 2 drops of croton oil, well mixed. If the case is persistent and the animal valuable then potassium iodide should be given in ten grain doses three times a day, either as a drench or in the drink. Turpentine should be applied over the loins until the skin becomes sore.

CONGESTION OF THE LUNGS.

This is a rather common affliction and very apt to be fatal. It is simply an engorgement of the pulmonary blood vessels (hyperaemia).

Cause.—Active exercise of swine in high flesh.

Symptoms.—These cases are usually acute and apt to end fatally. The symptoms are those of suffocation. There is marked distress; respiration is very rapid, even the mouth being held open in an effort to get air. The pulse is very rapid and weak and the animal is apt to fall suddenly.

On examination postmortem the pulmonary vessels are engorged and the lungs are dark. There is no definite exudate which distinguishes this from pneumonia, pneumonia being an inflammation of the lung tissues.

Treatment.—Stimulant: Use aromatic spirits ammonia 1 dram; alcohol 4 drams, in water repeated at short intervals; for example, 15 minutes to one-half hour. The animal must be kept warm and the extremities rubbed vigorously.

QUINSY.

Symptoms.—There is a marked sore throat. The neck is swollen back of and beneath the lower jaw. There is difficult respiration. Prognosis is usually favorable.

Treatment.—Hot fomentations around the swollen neck and the following prescription may be given internally. Fluid extract belladonna 4 drops; chlorate of potash 10 grains, three times a day in 2 oz. water.

SUGGESTIONS.

Drenching swine.—Put a piece of rubber hose on the neck of bottle, give medicine slowly and cautiously, and if possible when the animal is not squealing. The animal may either be thrown down and held, or tied, or a loop may be passed around the upper jaw back of the front teeth and held by a turn around a post; but in this case, medicines must be given with great care.

Black teeth.—Black teeth in young pigs is not a matter of serious importance, so far as the teeth are concerned.

LECTURE LIV.

OBSTETRICS.

The science which deals with the birth of young animals.

Anatomy.—The female organs studied in obstetrics are: ovaries, Fallopian tubes, vagina, and uterus.

Ovaries.—Two more or less flattened, spherical organs, suspended in the front part of the broad ligament (see uterus) in the sub-lumbar region. In the cow and mare they are about the size of hulled walnuts. Their function is to develop, mature and discharge the ovules or eggs.

Fallopian tubes.—Two small slender tubes which connect the ovaries, one on each side, with the horns of the uterus. Ovules or eggs pass through these tubes on their way to the uterus.

Uterus (*womb*).—A muscular and membranous sack, very large in pregnant animals—located partly in the pelvic and partly in the abdominal cavities.

Structure.—Three layers or coats, (a) outer or peritoneal; (b) middle, muscular; (c) inner, mucous.

The outer (a) is the thin, delicate, glistening membrane, peritoneum, which lines the entire abdominal cavity and covers with another layer, every organ within that cavity.

The middle (b) is composed of two distinct sets of muscle fibers. The outer fibers extend lengthwise, and the inner ones around the uterus.

The inner (c) is a mucous membrane and very similar to that which lines the mouth and whole alimentary canal.

Shape.—The body of the uterus is cylindrical and divides in front into two branches. Each branch connects with a Fallopian tube and through that with the ovary. The body of the uterus narrows behind to a neck which projects into the vagina. The rectum is above the uterus and the bladder below it.

Supports.—The uterus is held in place by four ligaments which are mainly folds of the peritoneum. The most important of these are the broad ligaments. These are two wide folds of

the peritoneum which extend the whole length of the body and horns, one on each side. They attach in the sub-lumbar region above, and to the sides of the uterus below. A third ligament attaches above to the rectum, and a fourth below to the floor of the pelvis.

Openings.—Three: one behind into the vagina; two in front for the Fallopian tubes.

Function.—The function of the uterus is to receive and mature the ovum after it has been fertilized. The ovum attaches to the uterine wall; a covering and supporting membrane is developed around it; and there the foetus develops, receiving a rich supply of oxygen and food materials from the maternal uterine walls, through the surrounding membranes by osmosis.

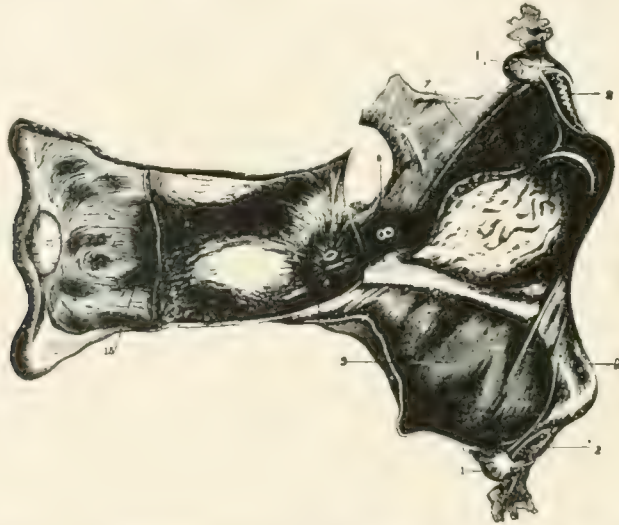


FIG. 81. GENERATIVE ORGANS OF THE MARE.

1, Ovaries; 2, Fallopian tubes; 6, horn of uterus intact; 7, horn of uterus laid open; 8, body of uterus; 9, broad ligament; 10, cervix or neck of the uterus; 13, outlet of the urethra.

Vagina.—This is a membranous tube which contains much muscular tissue in its walls.

Structure.—Three coats, (a) outer of loose connective tissue; (b) middle, muscular; (c) inner, mucous.

Location.—In the pelvis between the rectum above and the floor of the pelvis below. It is capable of great dilation to allow the passage of the young at birth. Between the uterus and vagina the connection or common opening is through the neck, at which point the uterus narrows greatly and is composed of firmer tissue. As the time for delivery approaches, this narrow canal dilates until the opening is large enough for the young animal to pass through.

Normal period of gestation. —This varies from two years in the elephant to 28 days in the rabbit. The cow carries young 283 days; mare 345 days; sow 119 days; ewe 149 days. All these may vary greatly. Old animals usually carry longer than young.

ACCIDENTS OF PREGNANCY.

Most important.—(a) Abortion; (b) retention of the foetus; (c) volvulus (twist in the neck of the uterus).

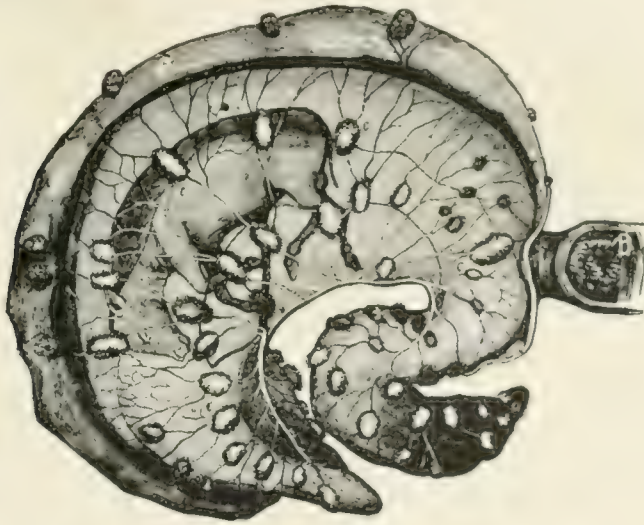


FIG. 82. BOVINE FOETUS AND FOETAL MEMBRANES AT MID-TERM.

Uterus opened on the right side, exposing foetus and membranes. Note the small, light-colored bodies (cotyledons) which connect uterus and membranes. See also Fig. 83. A, uterus; B, cervix (neck of uterus).

(a) **Abortion.**—For the purpose of this lecture, abortion may be defined as any premature birth.

They are either (1) sporadic, or (2) infectious.

(1) *Sporadic abortions* may be due to a great variety of conditions; e. g., sudden change in the weather and exposure to cold; strong medicines, especially purgatives; mechanical injuries; sudden and unaccustomed exercise; extreme nervous excitement; diseases accompanied by cough or severe pain or high fever; ergot, smut, etc., on the food; water containing sewage; disease of the uterus; lack of constitutional vigor in either sire or dam.

(2) *Infectious abortion* is probably due to a distinct contagium; i. e., to the action of living germs upon the uterus and placental membranes. Certain conditions of the atmosphere, diet, and vitality may favor the outbreak.

This type of the abortion does not spread rapidly through a herd, but the cases come at intervals throughout the season of pregnancy until a large percentage of the herd has aborted.

Preventive treatment.—The uterus can frequently be quieted and a threatened abortion prevented by the early administration of tincture of opium and f. e. viburnum given as follows:

	Cow or mare.	Sheep.
Tinc. opium	2 oz.	2 drams
F. e. viburnum prunifolium.....	3 oz.	3 drams
Syrup	10 oz.	2 oz.

Repeat every two hours until labor pains cease or the abortion occurs.

Prevention.—When a case of abortion occurs in any herd or flock, begin a search for the cause. If this cause continues in operation, a large number of animals may be affected. The animal that has already aborted should be removed at once from the shed or stable where the others are confined. All foetal membranes and discharges from the vagina must be burned or buried, and the stall where the abortion occurred should be disinfected with 5% crude carbolic acid. If possible a special attendant should take care of animals that have aborted. Animals which have aborted should not be placed with the others again until 15 days after discharge from vagina has ceased.

Symptoms of approaching abortion are frequently meager and rarely very plain. Sometimes there is a discharge from the vagina. This organ is swollen and the mucous membrane may be deeply congested. Slight labor pains sometimes appear several hours before the foetus is expelled and before the sac is ruptured. Occasionally the animal may be noticed moving around uneasily.

Result of abortion.—In the infectious type more frequently than in the other, the membranes are retained and slow blood poisoning ensues. Garget may appear which seems to be associated with the condition of the uterus. The appetite is impaired or lost. The patient loses flesh and gets very weak and thin and may come in heat frequently, but does not become pregnant again for a long time.

LECTURE LV.

OBSTETRICS.

ACCIDENTS OF PREGNANCY.

(b) **Retention of the foetus.**—This trouble is most common in cows. Period may vary from normal up to five years. Foetus may be alive in the cow for at least a year from pregnancy. It may be dead and mummified or it may decompose.

Symptoms.—The mother may show labor pains at normal time and all other symptoms of parturition may be present. The symptoms disappear and the cow goes on as if non-pregnant, but does not usually come in heat.

Causes.—Partial paralysis of the uterus; excessive adhesions between foetus and uterus; deformed pelvis; torsion of uterus, etc.

Treatment.—At normal period of delivery dilate the neck of the uterus with the aid of belladonna ointment and gentle mechanical force, and deliver. If the cow has gone safely past this period then fatten and sell for beef.

(c) **Volvulus (or twist).**—A twist sometimes occurs in the neck of the uterus and makes delivery exceedingly difficult.

It is much more common in the cow than in the mare, and usually occurs near the termination of pregnancy.

Cause.—It may be caused by the patient slipping or falling, and especially if she rolls over late in the period of pregnancy. Some authors think it may be due to active and unusual movements of the foetus. It can only be diagnosed positively by examination with the hand and finding the twist in the neck of the uterus.

Treatment.—If the twist is slight, the operator may be able to reduce it by introducing the hand into the uterus and grasping some portion of the foetus and causing the uterus to unwind, by a strong twisting motion. Sometimes it is necessary to throw the cow or mare, then introduce the hand, grasp firmly one or more limbs of the foetus and have the cow rolled in the opposite direc-

tion from the twist, holding firmly to the foetus meanwhile. If the operator can succeed in getting his hand into the uterus, and especially if he can get one or more foetal limbs through the neck of the uterus, the twist may usually be reduced. Some of these cases, however, are exceedingly difficult to handle.

ACCIDENTS OF PARTURITION.

The most common are: (a) germ infection; (b) inversion of the uterus; (c) tear in the vagina; (d) retention of foetal membranes; (e) haemorrhage.

(a) **Germ infection** may cause blood poisoning. When introducing the hand or any other foreign body, be sure that it has not recently touched what is dead or putrefying.

(b) **Inversion of the uterus.**—Most common in the cow—may be partial or complete. There may also be partial eversion of the bladder, and vagina.

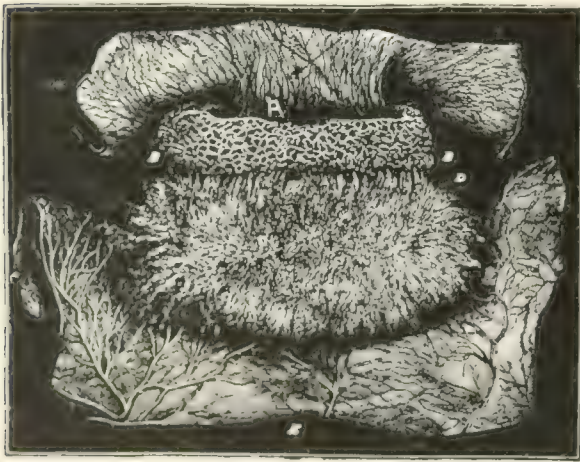


FIG. 83. BOVINE COTYLEDONS.

A, Pedicle of uterine cotyledon; B, uterine cotyledon; D, foetal cotyledon; E, foetal membrane.

Causes.—May be excessive force used in aiding delivery, or failure of the uterus to contract after delivery.

Treatment.—Thoroughly cleanse the protruding uterus with hot water and invert over the hand and arm. Be careful to smooth out each fold and leave the uterus in a natural position.

If the uterus is greatly swollen and heavy, bathe in cold astringent solutions, like strong alum water, until the size is sufficiently reduced to permit replacement. A common washtub is very convenient for bathing the soiled and swollen uterus.

Bandaging very firmly with a wide roller of muslin forces out much of the blood, reduces the bulk, and allows handling of the uterus without injury. The bandage should be wide, and rolled from each end.

To put on the bandage, begin with the middle of the bandage

at the end of the uterus and carry the ends around in opposite directions, pulling firmly all the time so as to force the blood back into the general circulation. After replacing, it is sometimes advisable to pack the uterus with cotton and close the outlet by means of sutures through the vulva.

Finally give the cow three ounces tincture of opium and 2 ounces bromide of potassium in $\frac{1}{2}$ pint of syrup. Give mare two-thirds of this dose and the ewe one-eighth. Repeat in three hours if the animal is still straining. If necessary apply rope truss as shown in class room.

(c) **Tear in vagina.**—Vagina may be torn above or below by excessive size of the foetus; faulty position of the foetus or by excessive force used in delivery. This calls for immediate operation by a veterinarian, in case of a mare,—not so important for a cow.

(d) **Retention of the afterbirth.**—Most common in cows, less serious for cows than for mares.

Cause.—Unusual adhesion between uterus and placenta or very rapid contraction of the uterus after delivery.

Treatment.—For the mare the placenta should be removed within twelve hours if it fails to come away naturally; for the cow it is better to wait for 18 to 72 hours if the cow seems well.

Twist the membranes that appear on the outside into a tight rope, then introduce an oiled hand into the uterus and gently separate the placenta from the uterus at the cotyledons, pulling with the other hand outside.

(e) **Haemorrhage.**—This is rare in the lower animals. It is denoted by rapidly increasing paleness around the eyes and in the mouth and by quick feeble pulse. Blood may not appear on the outside and yet the bleeding be extensive. Give 3 oz. f. e. ergot at once, in 4 oz. syrup, and then give 1 oz. in 2 oz. syrup every hour if necessary up to a limit of six doses, and meantime pour ice water over the back and loins.

LECTURE LVI.

OBSTETRICS—DIFFICULT PARTURITION.

Nature's plan.—When the delivery occurs according to nature's evident plan, the ligaments of the pelvis relax; the water bag appears through the neck of the uterus and finally outside the vagina; the neck and vagina gradually dilate to accommodate the foetus, which presents first the apex of a wedge or cone.

Normal presentations.—We recognize two normal presentations, viz., the anterior in which the two front feet and the nose present, with the foetus resting upon its sternum, and the posterior in which the two hind legs and tail present, with the foetus resting the sternum.

Variations from these produce more or less difficulty in delivery according as the presentation differs more or less from the normal.

The cause of difficulty may lie with either the mother or foetus, more commonly with the latter.

If the fault lies with the mother, it is usually because of premature delivery; of extreme narrowness and closeness of the pelvic outlet; volvulus; deformities of the pelvis (sometimes fracture); tumors within the pelvis; induration or hardening of the uterine neck. Sometimes there is complete closure, and sometimes the trouble is due to excessive accumulations of fat within the pelvis.

If the fault lies with the foetus, it is because of faulty presentations, excessive size, monstrosities or deformities of the foetus.

Common faulty presentations.—Faulty *anterior* may be: head, or head and neck doubled back; two feet, or feet and legs back; the neck and one front limb; or the neck and both front limbs back.

Faulty *posterior* presentation may be: one limb back and doubled at the hock or stifle; both limbs back with one flexed at

each of these points, or both flexed at the same joint, which may be either hock or stifle.

ASSISTANCE.

What may be needed. —Plenty of bland oil, e. g., linseed, two small window cords with smooth loops in one end of each to loop around limbs; one similar rope with short sharp hook in end to hook in under jaw, or eye socket; a pair of small combination pulleys, an embryotomy knife, large trocar and canula, some anti-septic, e. g., creolin to be used in 4% solution for hands, instruments and ropes.

Suggestions. —Do not interfere until the water bag has ruptured spontaneously unless labor pains have continued for several hours and water bag does not appear. If the water bag ruptures, in a natural way, and the head for example should present without the feet, or the head and one foot, or if one hind foot presents and not the other, or any evidently faulty presentation occurs, then it is time to examine and plan for assistance.

The first thing is to oil the arm and examine carefully to learn the cause of trouble and position of foetus. Then decide what you will do and how. If the condition is such that the delivery will probably be long and tedious, with the patient straining violently, it may be desirable to abate the labor pains with tincture of opium. Otherwise it will be much better and labor over sooner if the opium be not given. The rectum should also be examined as the hand goes into the vagina, and if distended should also be emptied.

The patient should stand or lie with head down hill. It is always much easier to operate with the patient standing. Be patient and not in too great a hurry, and make up your mind that you will succeed be it ever so difficult. When missing members are secured and ready to pull, pour plenty of oil, or in the absence of oil warm water into the uterus, by means of a funnel and rubber tubing. The parts that will offer friction are probably dry by this time and should be freely oiled or moistened.

It is frequently necessary to shove the foetus forward into the uterus in order to secure and straighten some missing parts, and for this purpose a smooth broom handle with a short brad in one end will do fairly well; but the hand of the operator must be guarding it, for fear it will slip and tear the mother. This is an

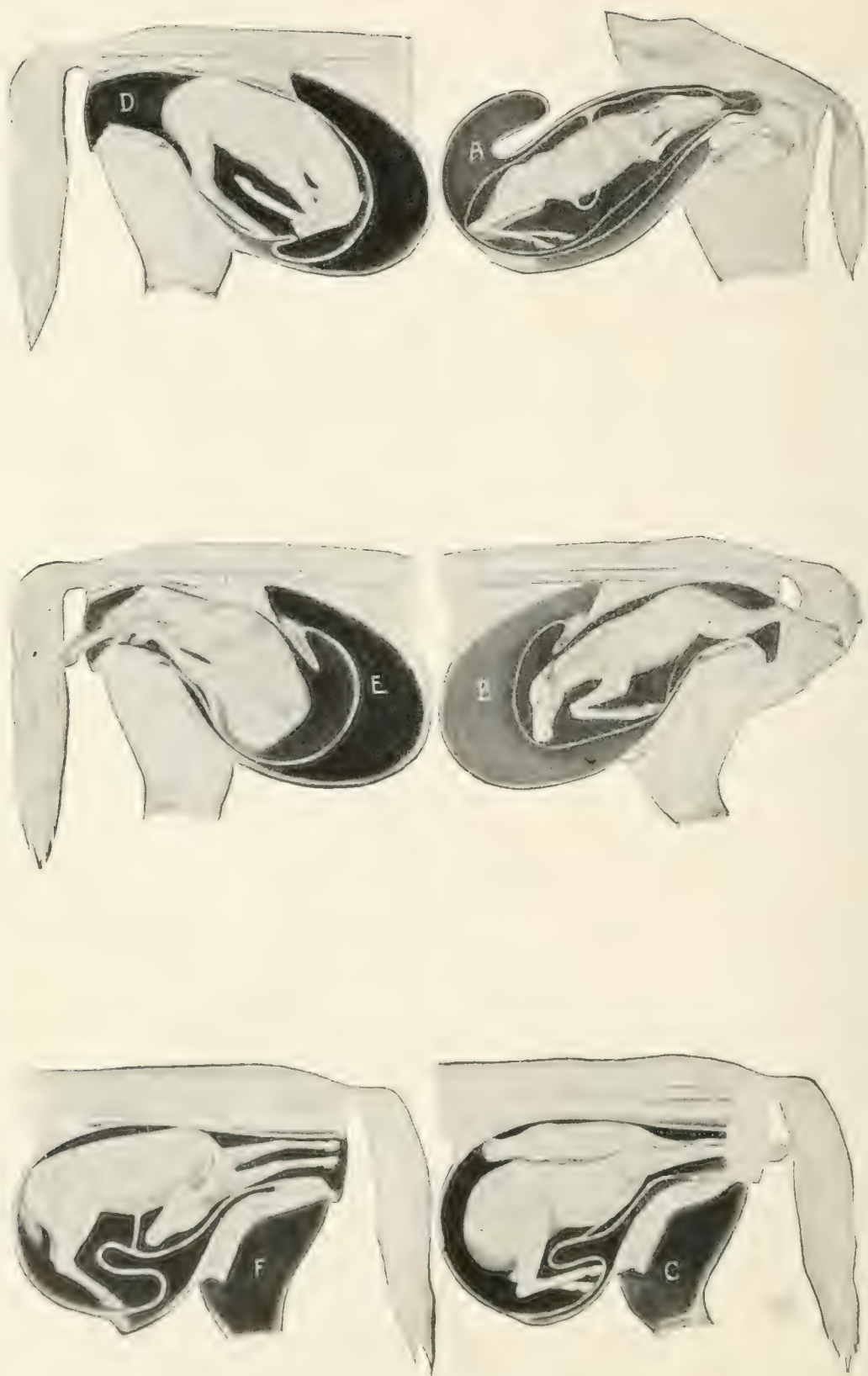


FIG. 84. PRESENTATIONS. (B. A. I.)
A and B, Normal; C, D, E, F, common abnormal presentations.

accident that must be carefully guarded against on account of probable blood poisoning.

When one part presents, and others are to be secured or when one has been secured and it is desirable to return it into the uterus to secure another part, always make sure of the progress gained by attaching one of the ropes to the part secured. If the patient cannot be made to stand, always have her on the side opposite the missing part which thus comes on top. Work between labor pains, and when all is clear and ready to pull, the assistance should be given moderately and while the mother is straining.

Dropsies.—Sometimes the retarded delivery is due to large accumulations of fluid in the brain cavity (hydrocephalus) of the foetus, or within the abdominal cavity (ascites) or to a general accumulation of fluids beneath the skin in the connective tissue and also in the abdominal cavity (general dropsy). In these cases the difficulty may be overcome by removing the fluid by tapping the brain and squeezing the soft bones together, or tapping the abdominal cavity and allowing the fluid to escape from these. A large trocar is very convenient for this operation.

Gaseous distention.—The difficulty may be due to an excessive accumulation of gases within the body of a dead and decaying foetus and the obvious treatment is to tap with trocar or knife and allow gas to escape.

Embryotomy.—If it becomes necessary to open the foetal body or remove one or more of the foetal limbs, the operator must observe certain general precautions.

Beware of injuring the maternal parts; be patient and don't be in a hurry.

In case of twins with both presenting at the same time, try to force one back into the uterus and deliver one at a time before attempting dissection which is usually very tedious and very exhausting to the operator and mother, as well.

Always save the skin and leave plenty to cover the bones and rough parts of the foetus, and to pull on.

Removing a fore limb.—Take the one that is presenting, draw out, as far as possible, cut around the ankle, and then cut the skin on the inside of the limb up to the body and dissect the skin loose from the limb, largely by fingers. Then cut the muscles between the limb and the sternum. By twisting and pulling at the same time the limb can then be removed entire, leaving the skin attached

to the shoulder. Do the dissecting with one hand, while the other pulls on the skin outside. The reasons for not removing the skin are plain. The soft parts are easily cut and torn when skin is off. The skin gives a strong object to pull by and protects the parts of the mother from bones. It also keeps the soft parts of the foetus from rolling up when pressed against the parts of the mother; and finally a dissection is more easily made under than outside the skin.

Removing the head.—Bring head outside vulva if possible, then cut the skin around the neck, back of the ears and dissect the skin loose from the muscles by the hand or by a thin spud, using the knife to cut the connective tissue bands that interfere, as far as the operator can reach. Then cut the cord on top of the neck that supports the head, and also the muscles around the vertebrae. Strong pulling and twisting on the head will usually bring away the head and neck, leaving a quantity of skin to cover remaining vertebrae and to assist in pulling.

Removal of the hind limbs.—This is done on the same general principle. Incision around the ankle, thence up on the inside of the limb to the articulation between the femur and the pelvis. Cut across this joint on the inside, in order to sever the ligament which holds the femur strongly to the pelvis. Then by strong pulling and twisting the limb can be torn loose at this joint.

It is rarely necessary to remove both hind legs. With one out of the way the other can usually be straightened or the body of the foetus removed with the other straightened forward into the uterus.

Caesarian section.—Removal of the foetus through the flank or median line of the belly is done sometimes, but only as a last resort, more commonly and successfully done with cows and sows than mares. This should only be attempted by a medical expert unless the plan is to save only the foetus. In the latter case the work must be done rapidly.

LECTURE LVII.

COMMON MEDICINES.

Common measurements.

Teaspoon holds about 1 dram ($\frac{1}{8}$ oz.).

Tablespoon holds about 4 drams ($\frac{1}{2}$ oz.).

Dessert spoon holds about 2 drams.

Tea cup holds about 5 oz.

Giving medicines.—Medicines may be given to domestic animals in the form of liquid drench, ball, in dry powder, or mixed with honey and molasss and smeared on the tongue. In giving a drench remember that a horse's mouth and throat are much more sensitive and more easily burned or irritated than the human. Taste of the medicine before giving if there is doubt about its being too strong. Powders should be finely pulverized and must not be caustic or irritating. Balls should be in the shape of a cylinder about 2 inches long and $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in diameter. They should be wrapped in thin paper and oiled. They must be reasonably soft and pliable and the horse should be offered a swallow of water immediately after giving.

Drenching.—In giving a drench the patient's head must not be held too high,, the face should be nearly horizontal, with the nose just a little higher. The operator must not be in a hurry. The medicine should be poured on top of the tongue and as far back in the mouth as possible. If the horse is obstinate about swallowing, pour a tablespoonful of water into the nose after each time medicine is poured into the mouth. Medicines should never be given through the nose because of danger of choking. For supporting the head to give a drench, a rope may be tied to the nose band of halter and thrown over the beam—never tied but held by an assistant. Better still a cloth loop may be passed around the upper jaw back of the front teeth and through the nose band of the halter in such way that it cannot slip off. This cloth loop is fastened to the overhead rope. Med-

icines may be given when the patient is lying down, but the operator must be careful not to pour out any medicine when the patient is about to struggle—danger of choking. Take plenty of time.

MEDICINES.

Aloes.—Cathartic, laxative or bitter tonic, depending upon the dose given. It is very reliable and satisfactory for horses, less so for ruminants. Very soluble in alcohol and boiling water, imperfectly so in cold water. Usually requires 15 to 20 hours for operation. It is often desirable to combine it with one-eighth to one-quarter its weight of ginger and should be given in conjunction with nux vomica in case the bowels are torpid. Large rectal injections of warm water may be given until the physic acts.



FIG. 85. HOLDING HORSE'S HEAD FOR DRENCHING.
(M. H. R.)

Note cloth loop under nose-band.

Doses.—Cattle, 1 to 2 oz.; horses, 2 to 8 drams; sheep, 4 to 8 drams; hogs, 2 to 4 drams.

These doses may be administered with ginger in a ball with lard or molasses, or given in water or syrup as a drench.

Alcohol.—Diffusive stimulant, diuretic, reduces fever, anti-spasmodic and diaphoretic. Large doses are strongly narcotic. Medicinal doses check spasmodic conditions of involuntary muscle fibres, stimulate the heart and lungs, equalize circulation and overcome extreme depression. Soluble in all proportions in water, should be diluted at least four times for internal use.

Doses.—Cattle, 2 to 4 oz.; horses, 1 to 2 oz.; sheep, $\frac{1}{2}$ oz.; hogs, $\frac{1}{4}$ to $\frac{1}{2}$ oz. Given in solution and diluted as above.

Boracic acid.—Non-irritating antiseptic, non-volatile. It is mainly used externally either in solution (about 3 per cent) or dry powder as dressing for wounds. Sometimes used internally for

colts and calves for diarrhoea. Soluble in 26 parts cold water; in 3 parts boiling water or in 6 parts alcohol.

Doses.—Colts and calves take 10 to 30 grains in syrup three times a day. Not irritating.

As an outward application for wounds and sores it may be mixed with half its bulk of iodoform.

Chloroform.—Stimulant, anti-spasmodic, anodyne, anæsthetic. Its stimulating effect resembles that of alcohol, but is less pronounced and more temporary. Applied externally, it evaporates rapidly and is cooling; but is very irritating when applied externally and confined.

Chloroform is very useful in colic and other spasmodic conditions, given internally with 6 to 8 times its bulk of raw linseed oil and well shaken.

It is very slightly soluble in water but dissolves freely in alcohol, ether or turpentine. Very useful in spasmodic colic given with oil as above.

Doses.—Horses and cattle take 4 to 8 drams repeated every two or three hours, if necessary till the patient staggers. Sheep and hogs take $\frac{1}{4}$ to 1 dram repeated frequently as for horses and cattle.

Carbolic acid.—Deodorizes, and kills germs. In strong solutions it is irritant, caustic and anæsthetic. Internally it is at first stimulating and afterwards depressing and narcotic. Poisonous in sufficient dose and strength. It is used more commonly for external purposes, especially as a germicide, in 2 to 5 per cent. solutions. Dilute solutions kill external parasites. It makes a good wash for foul sores and wounds from which the pus does not drain freely. Valuable in the treatment of ringworms used as 10 to 15 per cent. solution in glycerine or linseed oil.

Carbolic acid is very commonly used as an antiseptic dressing in surgical work (2 to 5 per cent. solutions). It is usually dispensed from the drug stores as a 95 per cent. solution of the crystalized drug.

Dose.—Horses and cattle take internally $\frac{1}{4}$ to 1 dram; sheep and hogs take 10 to 30 drops, administered per mouth as a drench and greatly diluted. It has been used with apparently good results for both after treatment, and prevention of infectious abortions in cattle, given either hypodermically, or injected into the jugular vein, or given as a drench per mouth.

Iodoform.—Used generally for external and local application. Is a deodorizer and prevents infection of wounds. A local antiseptic. Very useful as a dressing for wounds, especially after they have commenced to heal. May be used alone or mixed with twice its bulk of powdered boracic acid and dusted over the wound surface.

Common lime.—Is irritant, neutralizes acids, and astringent. Saturated solution which is very dilute, is useful in diarrheas and indigestions of young animals and may be given with milk quite freely. Carron oil (lime water and linseed oil in equal parts) is a very useful application for burns. Whitewashing is a nice and satisfactory method of disinfecting and cleaning up out-buildings.

Doses.—Horses and cattle take 1 to 2 drams of the quick lime; sheep $\frac{1}{4}$ to $\frac{1}{2}$ drams, very greatly diluted in all cases.

LECTURE LVIII.

COMMON MEDICINES.

Raw linseed oil.—Is used in veterinary practice to dilute stronger medicines in making liniments and various applications for external use and internally as a laxative or cathartic, depending upon the dose used. Very safe and but slightly irritating. Good for either horses, cattle, sheep or swine.

Doses.—Cattle take 2 to 4 pints; horses, 1 to 3 pints; sheep and hogs take $\frac{1}{4}$ to 1 pint.

Rectal injections of warm water may be given after the oil and it is desirable, if there is sufficient time, to prepare horses by several warm bran mashes before giving the oil.

Corrosive sublimate.—Is a caustic and irritant poison. Used externally as a caustic and antiseptic. Stronger solutions, and ointments produce very severe blisters and frequently destroy the hair follicles.

Chief use, as a germicide. Cheap and very satisfactory for disinfecting buildings and other purposes where large quantities must be used. Dilute solution destroys lice and itch mites in the proportion of 15 grains to the pint of water. For antiseptic and disinfecting purposes it may be used 4 to 7 grains to the pint.

Epsom salts.—A saline cathartic, causes a large secretion of fluids from the intestinal walls, thus rendering the bowel contents very fluid. Very satisfactory as a laxative or cathartic for cattle and sheep, not so good for horses. Useful in small doses given to horses in feverish conditions. Very soluble in water, will dissolve in its own weight of warm water, insoluble in alcohol.

Doses.—Cattle take for cathartic 1 to 3 pounds; sheep and hogs take $\frac{1}{4}$ to $\frac{1}{2}$ a pound. Frequently desirable to add $\frac{1}{4}$ to $\frac{1}{2}$ these doses of common salt and 1-6 the total weight of powdered ginger, and give as a drench. It is better to give quite dilute drenches; e. g., the cow's dose should be dissolved in 2 to 3 pints of water and the others in proportion.

Sodium chloride (common salt).—An essential article of food, restorative and antiseptic. Very large doses are cathartic and more or less irritating. For grown cattle and sheep in good

strength salt is a very useful cathartic. More commonly combined with other saline cathartics. Useful as a throat wash in certain sore throats, diluted to 5 per cent. solutions in water.

Sodium hyposulphite and sodium sulphite.—Antiseptic and deodorant especially valuable for internal administration, to check fermentation and septic processes in the stomach and intestines and therefore valuable in conditions of diarrhea, indigestions, and hoven or bloat. Also useful in small doses to control feverish conditions. Both the sulphite and the hyposulphite are readily soluble in water.



FIG. 86. TO THROW CATTLE. (M. H. R.)
Pull straight back on the rope.

Doses.—Horses and cattle take of the sulphite 8 to 12 oz.; sheep and swine take 4 to 8 drams. The doses of hyposulphite are much smaller—about half as large as for the sulphite. These doses are to be given as drenches, well diluted and repeated three times daily. Smaller doses may be given every hour in cases of bloat.

Saltpetre (nitrate of potash).—Mildly antiseptic, and has slight cathartic effect. It is diuretic, increases the secretion from skin and bronchial tubes; is alterative and febrifuge. Useful in

the treatment of all classes of animals. Very useful for external cooling effect when dissolved in water with sal ammonia. For alterative and febrifuge effect it is given in about half the doses that are given to stimulate the kidneys.

Saltpetre is very soluble in water.

Doses.—Cattle and horses for diuretic effect, $\frac{1}{2}$ to 2 oz.; sheep and swine, $\frac{1}{2}$ to 2 drams. These doses are given in the drinking water or as a drench. Not caustic.

Sweet spirits nitre.—Is a stimulant much like alcohol or ether; is antispasmodic and increases the excretion from skin, lungs and kidneys. Very large doses are narcotic. Very useful in cases of spasmodic colic and tympanites, and is a convenient heart stimulant.

Doses.—As a stimulant and antispasmodic horses and cattle take 2 to 4 oz.; hogs 2 to 4 drams. It is decomposed by water and should not be mixed with other medicines until just before giving. It is given as a drench with water or in syrup. As an antispasmodic it may be given to advantage with either opium or chloral hydrate.

Oil of turpentine (common turpentine).—Is stimulant, antiseptic, and destroys parasites, both external and internal. It is readily absorbed when swallowed and is excreted by the lungs, skin and kidneys. Over doses irritate the mucous membrane of these organs. For medicinal purposes it is used in indigestion, certain conditions of diarrhea and tympanites (bloating); a very useful medicine in these conditions and one that is usually at hand. It is slightly soluble in water, quite soluble in ether or alcohol or linseed oil.

Doses.—Horses and cattle, as stimulant and antispasmodic, taking 1 to 2 oz.; for stimulating effect upon mucous membranes of the bronchial tubes, skin or kidneys. The dose for sheep and swine should be about 1-6 of these quantities.

Opium.—Medicinal doses relieve pain and spasmodic conditions, reduce congestion and inflammation; check intestinal secretion and peristaltic movements; and with some animals produce sleep. The various preparations of opium are used in medicine for the purpose of relieving pain, perhaps more than any other agent. Opium is a typical anodyne (pain reliever), but there are very many conditions that arise in practice under which it should never be given, which it is not thought practical to explain in this

short lecture further than that the person who is giving opium to any domestic animal must not forget that it checks intestinal secretion and peristaltic movements and in this way may cause constipation at just the time when the reverse condition is desired.

Morphine is an alkaloid of opium and shows all the essential physiological properties of the crude drug. Cattle and sheep take very large doses. Morphine and various preparations of opium are frequently employed with advantage in spasmodic colic and may be combined with stimulants and anodynes like ether, sweet spirits nitre or chloral hydrate. It is usually advisable to give a mild laxative soon after the opium operates.

<i>Dose.</i>	<i>Horses.</i>	<i>Cattle.</i>	<i>Sheep.</i>	<i>Hogs.</i>
Crude opium.....	1-2 drs.	2-4 drs.	10-40 grs.	10-40 grs.
Morphine sulphate.	3-5 grs.	3-8 grs.	1/2- 2 grs.	1/2- 2 grs.
Tincture opium				
(Laudanum)	1-2 ozs.	1-3 ozs.	2- 6 drs.	2- 6 drs.

The tincture should be diluted with water or syrup the same as for alcohol.

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